URBEMIS7G for Windows
Computer Program User's Guide

Version 5.1.0
Emissions Estimation for
Land Use Development Projects

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We also wish to acknowledge Patrick C. Randall, who, as an air resources engineer for the California Air Resources Board, designed and developed the original version of URBEMIS, which was released in 1982. Without his creativity and dedication, URBEMIS7G would probably not exist today.

Table of Contents

List of Tables and Figures

Page

Table

Figure

I. INTRODUCTION

URBEMIS7G for Windows, Version 5.1.0, is a revised edition of URBEMIS7G for DOS, Version 3.2. Like its predecessors, URBEMIS7G for Windows is a software program designed to estimate air emissions from land use development projects. Previous versions of URBEMIS were designed to estimate only emissions from motor vehicle trips generated by land use development. URBEMIS7G for DOS was enhanced so that the user can estimate construction and area source emissions and select mitigation measures for construction emissions, area sources, and motor vehicle trips.

One major difference between URBEMIS7G for Windows and URBEMIS7G for DOS is that URBEMIS7G for Windows has been written specifically to run in the Windows 95/98 environment. Consequently, its look and feel is substantially different from previous versions. Another major difference is that URBEMIS7G for Windows can have several projects open simultaneously (limited only by system memory). Further, a red/green arrow system provides the user with a visual reference about whether the emission calculations reflect the latest changes to land use, construction, area, and operational assumptions. Other minor enhancements include revision of the trip-generation rates associated with the land-use selection options, addition of oxides of sulfur (SO_x) emissions to the output files, and addition of a print option for EMFAC7G files.

II. GETTING STARTED

II.1 Memory Requirements

URBEMIS7G for Windows is written in Microsoft Visual Basic for Windows, Version 6.0. Therefore, unlike previous versions, URBEMIS7G for Windows does not have a memory limit when operating in the Windows 95/98 environment.

II.2 Disk Limits

URBEMIS7G for Windows does not require a substantial amount of hard disk space: Less than 4 megabytes (MB) of hard disk space are required for all URBEMIS7G for Windows files (i.e., executable files and EMFAC7G files). However, at least 1 MB of additional hard disk space should be available to store project files.

II.3 Installation

Three files are required for installing URBEMIS7G for Windows: SETUP.EXE, SETUP.LST, and URB7GWIN.CAB. Before beginning installation, close any other programs that are running.

If URBEMIS7G for Windows is being installed from a compact disc (CD), navigate to the CD and double click on SETUP.EXE. The installation program will then guide you through the installation process.

If URBEMIS7G for Windows is being installed from files located on a Web site, from a diskette, or received by e-mail, first download or copy the three installation files to your hard drive, then navigate to the files and double click on SETUP.EXE. The installation program will then guide you through the installation process.

II.4 Starting URBEMIS7G

After URBEMIS7G for Windows has been installed successfully, it can be opened as follows: click on the Windows "Start" button in the lower left corner of the screen, select "Programs" from the vertical list of options, select "URBEMIS" from the vertical list of programs, and select URB7GWIN.CAB to start the program.

One frequent problem when starting URBEMIS7G is that the program does not fit entirely within the computer screen. The optimal screen settings for running URBEMIS7G are 1024 by 768 pixels, with the small fonts advanced setting option. These settings can be changed by selecting the Start button from the Windows desktop, selecting the Settings option from the vertical menu, selecting Control Panel, and selecting Display.

III. USING URBEMIS7G

III.1 Differences from Previous Versions

III.1.1 Additions

Several versions of URBEMIS have been released by the California Air Resources Board (ARB) since the early 1980s: URBEMIS1, URBEMIS2, URBEMIS3, AND URBEMIS5. URBEMIS4 was not released for public use. Previous versions of URBEMIS allowed the user to estimate motor vehicle emissions from vehicle trips generated by land use development projects. Generally, each new release of URBEMIS is associated with an update of the ARB's motor vehicle emission factors.

URBEMIS7G is the successor to URBEMIS5, and the two versions differ in several ways, as described below:

- URBEMIS7G is an updated version of URBEMIS5: it includes EMFAC7G, the ARB's California motor vehicle emission factors model.

- URBEMIS7G now allows users to estimate construction and area-source emissions; select mitigation measures for construction, area-source, and motor vehicle emissions; and estimate emissions benefits of the mitigation measures.

- URBEMIS7G includes a series of enhanced land-use selection screens, which include additional land uses, updated trip-generation rates, trip-generation rates for certain land uses based on equations included in the ITE Trip Generation Manual Version 6.0 (Institute of Transportation Engineers 1991), and an option to specify if the project is located is an urban or rural environment.

- URBEMIS7G estimates road dust emissions for both paved and unpaved roads, whereas previous versions of URBEMIS did not allow estimation of re-entrained road dust.

- URBEMIS7G contains a new “double-counting” option that is designed to minimize double counting of internal vehicle trips between residential and nonresidential land uses.

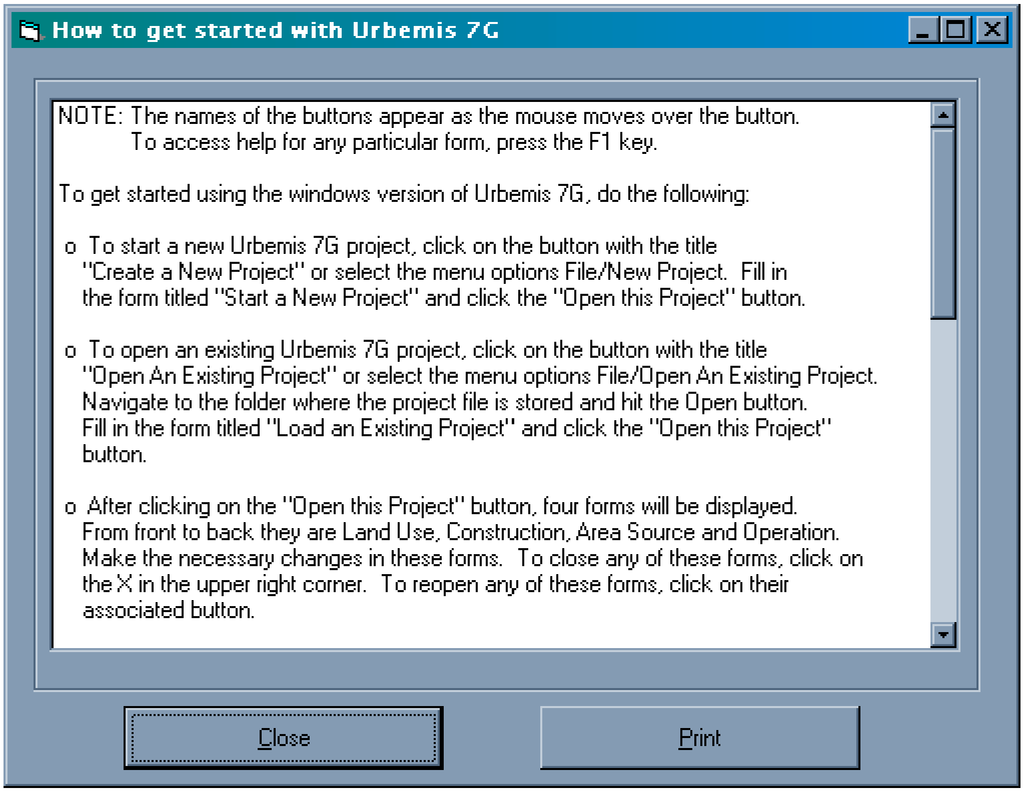
- URBEMIS7G allows the user to select a new “pass-by trips” option that estimates vehicle-trip emissions based on the percentage of primary trips, diverted linked trips, and pass-by trips assumed for specific land use types.

III.1.2 Appearance

URBEMIS7G's appearance is substantially different from previous versions because it is written in Microsoft's Visual Basic for Windows 6.0. This language allows development of data-entry forms that appear similar to a user's default Windows desktop screen setup.

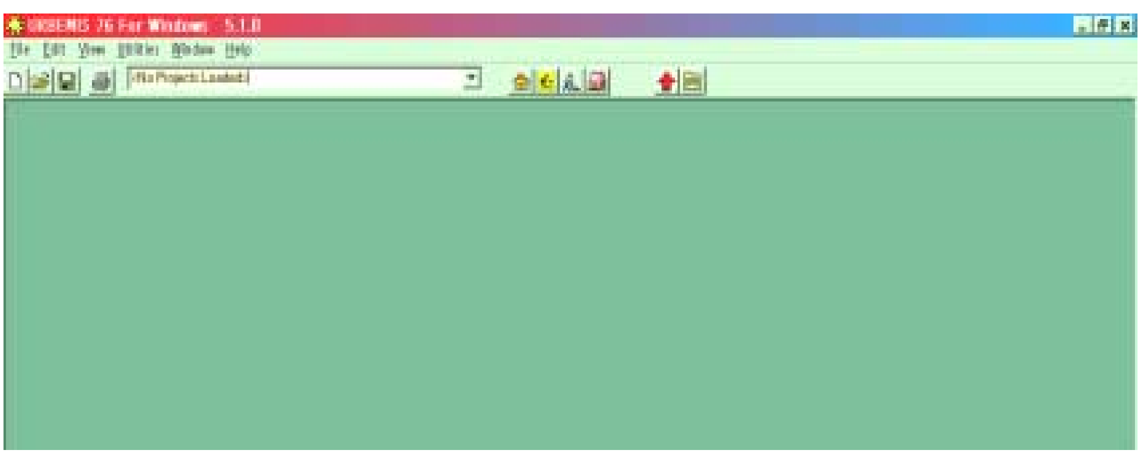
When URBEMIS7G is started, an introductory screen, which is titled “How to Get Started with URBEMIS7G” and includes the basic information needed to start URBEMIS7G, is shown (Figure 1). The information in the introductory screen can be viewed from within the program, or it can be sent to the default printer by clicking on the print icon.

Figure 1. Introductory URBEMIS7G for Windows Screen



After the introductory screen is closed, URBEMIS7G displays the user the initial screen shown in Figure 2.

Figure 2. URBEMIS7G Initial Screen



The screen is essentially blank except for a row of icons (the Icon Bar) and a row of words (the Menu). On the Icon Bar, four icons are located to the left of the display showing the name of the currently loaded project. From left to right, these icons are to “Create a New Project”, “Open an Existing Project”, “Save Project Settings to File from Memory”, and the “Print Selected Results”. Six icons are located to the right of the display. From left to right, the first four icons are “Land Uses”, “Construction Emissions”, “Area Sources”, and “Operational” (or “Motor Vehicle”). The last two icons are the “Up Arrow”, which updates emission results based on changes to project assumptions, and “View Results”, which allows the user to send the emission results to a file, a printer, or the screen.

The Menu contains six words: File, Edit, View, Utilities, Window, and Help. Clicking on File from the Menu displays a drop-down box that gives the user the option of opening or closing projects, saving projects to disk, printing files, or exiting the program. Selecting Edit from the Menu allows the user to cut and paste from within URBEMIS7G. View gives the user the option of opening a form, closing all open forms, or recalculating the results. The Utilities option lets the user edit the directories where files are stored. The Window option allows the user to open the Help forms, which can also be reached from anywhere within the program by pressing the F1 button on the keyboard.

III.1.4 File Structure

Please note that because URBEMIS7G for Windows uses a different file structure than previous versions of URBEMIS, project files generated by previous versions of URBEMIS (including URBEMIS7G for DOS) are <u>not</u> readable by URBEMIS7G for Windows. Attempting to read files from previous versions will generate an error message. Likewise, project files created by URBEMIS7G for Windows cannot be read or used by earlier versions of URBEMIS.

III.2 Program Overview

As stated, on starting URBEMIS7G, the introductory screen titled “How to Get Started with URBEMIS7G” appears (Figure 1). This screen contains instructions for quickly starting the URBEMIS7G for Windows program.

III.3 Setting Directories

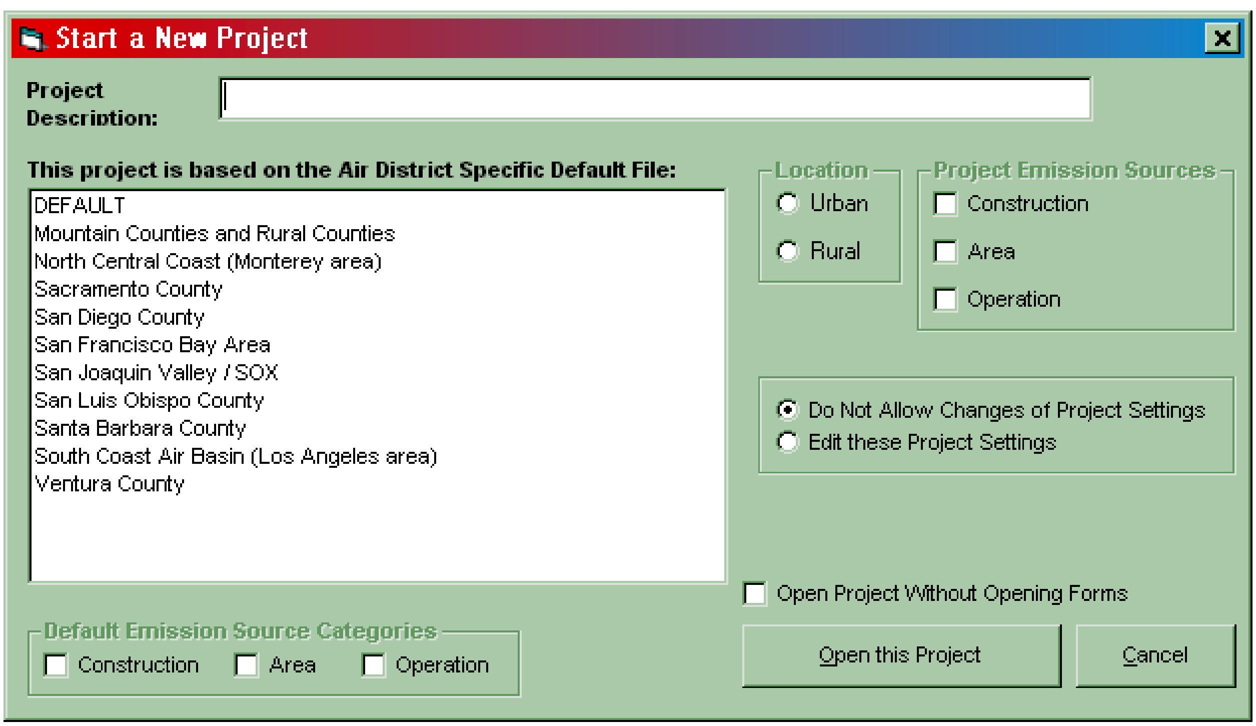
On starting URBEMIS7G, the URBEMIS7G main menu is shown. The directories, which specify the location from and to which URBEMIS7G reads and writes files, should be set correctly before proceeding (see Section III.11, “Setting Directories).

III.4 Beginning a New Project

From the initial screen, a new project is begun by selecting "File" from the Menu and selecting "New Project" from the drop-down menu, or by selecting the far left "New Project" icon. After either option has been selected, URBEMIS7G loads a screen titled "Start a New Project" (Figure 3), which requires the user to enter a project description and select the air basin or air district (from a list of 10) in which the project will be located. The default information for the selected basin is loaded into the project location (rural or urban), and emissions for each project emission source category (construction, area, and operational) will be calculated. The information included in the default file has been supplied by the respective air districts. The project setting and project emission source categories can be modified by the user by selecting the "Edit These Project Settings" line (Figure 3).

A checkbox has been included on this screen that allows the user to "Open Project Without Opening Forms". If this box is not checked, then when the user clicks the "Open this Project" button, URBEMIS7G loads the land use screens and the project emission source screens. If the "Open Project Without Forms" checkbox is checked, once the user clicks on the "Open this Project" button, then URBEMIS7G presents the user with the icon bar and an empty screen (Figure 2). The user must then click on the land use screen (house) icon to continue entering information on the new project.

Figure 3. New Project Screen



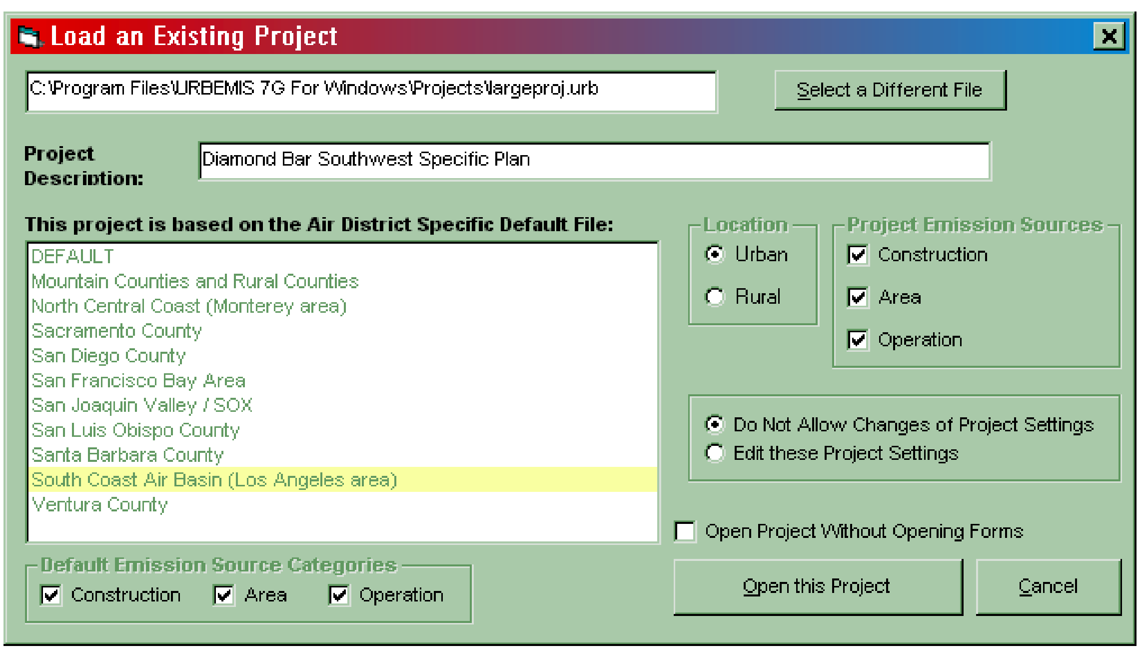
III.5 Open an Existing Project

From the default menu, an existing project is selected by first selecting "File" from the Menu and "Open an Existing Project" from its drop down menu, or by selecting the "Open an Existing Project" icon, which located to the right of the "New Project" icon (i.e., second in from the left). Once either option has been selected, URBEMIS7G will load a screen titled "Select a Project File". At this point, a file can be chosen by double-clicking on or entering its name, or the directory from which the file will be selected can be changed. If a file name is entered that does not exist in a selected directory, URBEMIS7G flashes a message that the selected file does not exist. **As stated, please note that URBEMIS7G uses a different file structure than previous versions of URBEMIS (including URBEMIS7G for DOS). If you attempt to load a file created with an earlier version of URBEMIS7G, you will receive an error message.**

Once the user chooses an existing project, URBEMIS7G displays a screen titled "Load an Existing Project" (Figure 4), which allows the user to edit the project description, air district default file, project location (rural or urban), and project emissions source categories (construction, area, or operational).

A checkbox has been included on this screen that allows the user to "Open Project Without Opening Forms". If this box is not checked, URBEMIS7G will load up to four emission source screens when the "Open this Project" button is clicked. The screens include the construction, area, and operational screens (if they are checked), as well as the land uses screen. If this box is checked, URBEMIS7G will display the Icon Bar and an empty screen once the user clicks on the "Open this Project" button. The user must then click on the "Land Use" icon to edit information for the opened project.

Figure 4. Load an Existing Project Screen



III.6 Specifying Land Uses

If a project is opened with all forms open, a display as shown in Figure 5 will appear. The land uses screen is shown in front of construction, area sources, and operational emissions screens. The first land use screen displays the first of six possible land use screens, which are organized as follows: residential, educational, entertainment, retail, commercial, and industrial.

Land uses associated with any of the six land use screens can be accessed by clicking on the appropriate tab. If a project is opened without forms automatically opened, the land use screens must be opened manually by clicking on the “Land Use” icon on the Menu.

Figure 5. Land Uses Screen

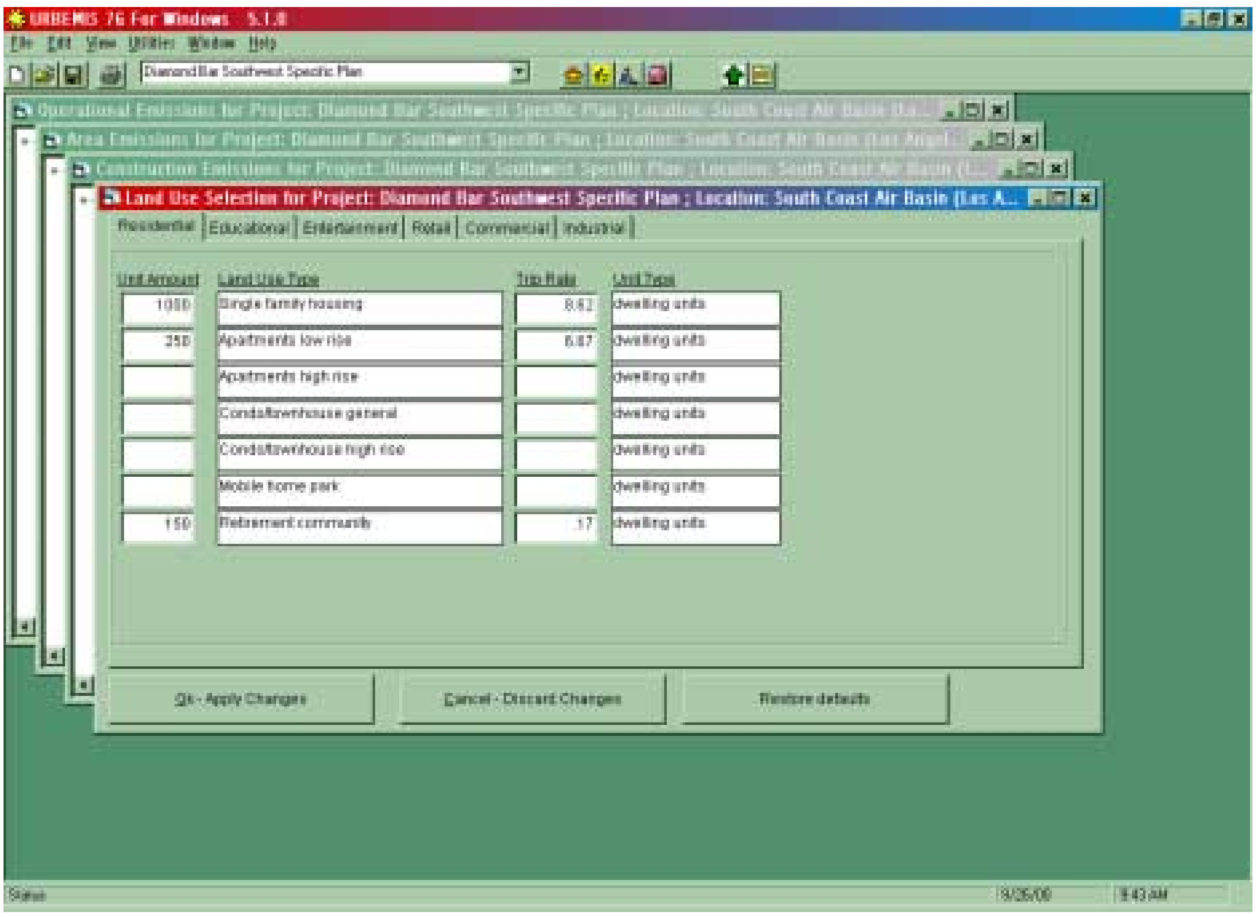


Table 1 lists the land uses in URBEMIS7G, provides a definition of each land use, and shows the percentage of trips associated with each land use made by those working at that land use. These percentages, called Percent Worker Commute in Table 1, are based on percentages for the same or similar land uses in previous versions of URBEMIS and on estimates of estimates of reasonable percentages for new land uses.

The option of entering the project size or unit amount is available for each land use. URBEMIS7G automatically calculates the trip rate based on the unit amount, using information taken from the ITE Trip Generation Manual and/or the San Diego Traffic Generators Manual. The equation or value used to estimate trip generation and its reference are shown in Table 2. You can override the trip rate by typing in a different rate. For certain land uses, you also can select a different unit type by clicking on the "Unit Type" arrow (if it is shown for that particular land use). If a land use's unit type does not have an arrow, then you can simply edit the name of the unit type. You can also edit the name of the land use type.

For all nonresidential land uses, you also have the option of modifying the default "% Worker Commute" value. This value represents the percentage of worker commute trips attracted to that land use as a percentage of all trips generated by that land use.

Once you have finished entering land uses, you must click the OK-Apply Changes button to save those changes to memory. Please note that by clicking on OK-Apply Changes button will not save those changes to a file. Saving changes to a file is described in Section 3.12.

Table 1. Land Use Definitions and Percent Worker Commute

	Land Use Definition	Percent Worker Commute*
First Land Use Screen		
Single-family housing	Detached homes on individual lots.	N/A
Apartments, low rise	Buildings with one to 10 stories.	N/A
Apartments, high rise	Buildings with more than 10 stories.	N/A
Condo/townhouse general	Condos and townhouses in buildings with one or two levels.	N/A
Condo/townhouse high rise	Condos and townhouses in buildings with three or more levels.	N/A
Retirement community	Self-contained villages restricted to adults or senior citizens.	N/A
Mobile homes	Trailer homes sited on permanent foundations.	N/A
Second Land Use Screen		
Elementary school	Generally includes kindergarten through either 6th or 8th grades.	20
Junior high school	Includes 7th, 8th, and often 9th grades.	20
High school	Includes 10th, 11th, 12th, and often 9th grades.	10
Junior college (2 years)	Most have facilities separate from other land uses and exclusive access points and parking facilities.	5

	Land Use Definition	Percent Worker Commute*
University/college (4 years)	Four-year and graduate educational institutions.	5
Library	Public or private facility that houses books and includes reading rooms and (possibly) meeting rooms.	5
Place of worship (weekend)	Building that provides public worship services.	3
Place of worship (weekday)	Building that provides public worship services.	3
Blank (edit all 5 columns)	Blank commercial land use that can be entered by the URBEMIS7G user.	2
Third Land Use Screen		
Racquet club	Privately owned facilities with tennis, racquetball, and/or handball courts, exercise rooms, and/or swimming pools and/or weight rooms	5
Racquet/health club	Privately owned facilities with tennis, racquetball, and/or handball courts.	5
Daycare center	Facilities that care for preschool children, normally during daytime hours. May also include after-school care for older children.	5
Quality restaurant	Typically with customer turnover rates of at least 1 hour.	8
High turnover (sit-down restaurant)	Typically with high customer turnover rates of less than 1 hour.	5
Fast Food Restaurant with Drive-Through	Includes fast food restaurants with drive-through windows, such as McDonald's, Burger King, and Taco Bell.	5
Fast food restaurant without drive-through	Includes fast food restaurants without drive-through windows, such as McDonald's, Burger King, and Taco Bell.	5
Hotel	Place of lodging that provides sleeping accommodations, restaurants, and meeting or convention facilities.	5
Motel	Place of lodging that provides sleeping accommodations and often a restaurant.	5
Fourth Land Use Screen		
Free-standing discount store	Free-standing store with off-street parking. Can be part of neighborhood shopping centers.	2

	Land Use Definition	Percent Worker Commute*
Free-standing discount superstore	Same as free-standing discount store but includes full-service grocery department under the same roof.	2
Discount club	Discount/warehouse store whose shoppers pay a membership fee to take advantage of discounted prices.	2
Regional shopping center, greater than 57,000 square feet	Integrated group of commercial establishments that are planned, developed, owned, and managed as a unit.	2
Regional shopping center, less than 57,000 square feet	Integrated group of commercial establishments that are planned, developed, owned, and managed as a unit.	2
Supermarket	Free-standing retail store selling a complete assortment of food, food preparation and wrapping materials, and household cleaning and servicing items.	2
Convenience market (24 hour)	Market that sells convenience foods, newspapers, etc. but has no gasoline pumps. (Trip generation rates with gas pumps is approximately 12% higher than without.)	2
Convenience market with gas pumps	Market that sells convenience foods, newspapers, etc. and has gasoline pumps.	2
Gasoline/service station	Retail market that sells gasoline and may repair vehicles. Excludes gasoline stations with convenience stores or car washes.	2
Fifth Land Use Screen		
Warehouse	Building devoted to the storage of materials and includes office and maintenance areas.	2
Bank (with drive-through)	Bank with one or more drive-through windows.	2
General office building	Houses multiple tenants in a location where affairs of businesses, commercial, or industrial organizations or professional persons or firms are conducted.	35
Office park	Contain general office buildings and related support services, arranged in a park- or campus-like setting.	48
Government office building	Individual building containing the entire function or simply one agency of a city, county, state, or federal government.	10

	Land Use Definition	Percent Worker Commute*
Government (civic center)	Group of government buildings connected by pedestrian walkways	10
Medical office building	Includes both medical and dental office buildings that provide diagnoses and outpatient care. Generally operated by one or more private physicians or dentists.	7
Hospital	Institution where medical or surgical care is give to nonambulatory and ambulatory patients and overnight accommodations are provided.	25
Sixth Land Use Screen		
General light industry	Typical light industrial activities, including print plants, material testing labs, and assemblers of data processing equipment. They employ fewer than 500 persons and tend to be free-standing.	50
General heavy industry	Could also be categorized as manufacturing facilities, but are limited to production of large items.	90
Industrial park	Contains a number of industrial or related facilities and is characterized by a mix of manufacturing, service, and warehouse facilities. May contain highly diversified facilities, a number of small businesses, or one or two dominant industries.	41.5
Manufacturing	Site where the primary activity is the conversion of raw materials or parts into finished products. May also include associated office, warehouse, research, and other functions.	48

* Represents the percentage of total trips that are work-related commute trips.

Table 2. URBEMIS7G Trip-Generation Rates

Land Use	Trip-Generation Rate Fitted Curve Equation or Average Rate	X or Units [a]	Source [b]
Single-family housing	Ln(T) = 0.920 Ln(X) + 2.707	Dwelling Unit	ITE (210)
Apartment, low rise	(T) = (5.124 (X) + 387.526)	Dwelling Unit	ITE (211)
Apartment, high rise	Ln(T) = 0.825Ln(X)+2.502	Dwelling Unit	ITE (222)
Condo/townhouse, general	Ln(T) = 0.850 Ln(X) + 2.564	Dwelling Unit	ITE (230)
Condo/townhouse, high rise	Ln(T) = 3.771 Ln(X) + 233.657	Dwelling Unit	ITE (232)

Land Use	Trip-Generation Rate Fitted Curve Equation or Average Rate	X or Units [a]	Source [b]
Mobile home park	Ln(T) = 3.274 Ln(X) + 300.864	Dwelling Unit	ITE (240)
Retirement community	2.76	Dwelling Unit	ITE (250)
Elementary school	Ln(T) = 0.718 Ln(X) + 3.496	1000 sq. ft.	ITE (520) [c]
Elementary school	Ln(T) = 1.007 Ln(X) – 0.086	Student	ITE (520)
Junior high school	11.92	1000 sq. ft.	ITE (522)
Junior high school	Ln(T) = 1.559 Ln(X) – 3.507	Student	ITE (522)
High school	Ln(T) = 0.721 Ln(X) + 3.759	1000 sq. ft.	ITE (530) [c]
High school	T = {[(0.420/X) + 0.00027]**-1}	Student	ITE (530) [c]
Junior college (2 years)	18.36	1000 sq. ft	ITE (540)
Junior college (2 years)	T=1.450(X) + 610.265	Student	ITE (540)
University/college (4 years)	T = 2.229(X) +439.995	Student	ITE (550)
Library	Ln(T) = 0.681 Ln(X) + 5.043	1000 sq. ft.	ITE (590)
Place of worship (Sunday trip rate)	Ln(T) = 0.593Ln(X) + 4.766	1000 sq. ft.	ITE (560)
Place of worship (weekday trip rate)	9.11	1000 sq. ft.	ITE (560)
Racquet club	17.14	1000 sq. ft.	ITE (492)
Racquetball/health club	40	1000 sq. ft.	SANDAG [d]
Daycare center	79.3	1000 sq. ft.	ITE (565)
Quality restaurant	Ln(T) = 0.900 Ln(X) + 4.746	1000 sq. ft.	ITE (831) [c]
High-turnover (sit-down) restaurant	130.34	1000 sq. ft.	ITE (832)
Fast food restaurant (no drive-through window)	716	1000 sq. ft.	ITE (833)
Fast food restaurant (drive-through window)	710.1	1000 sq. ft.	ITE (834)
Hotel	T = 8.946(X) – 368.112	Rooms	ITE (310)
Motel	Ln(T) = 0.973 Ln(X) + 2.298	Rooms	ITE (320)
Free-standing discount store	Ln(T) = 1.654 LN(X) + 0.911	1000 sq. ft.	ITE (815)
Free-standing discount superstore (1)	T = 59.492(X) - 1930.270	1000 sq. ft.	ITE (813)
Discount club (2)	41.8	1000 sq. ft.	ITE (861)
Regional shopping center	Ln(T) = 0.643 Ln(X) + 5.866	1000 sq. ft.	ITE (820)
Supermarket	111.51	1000 sq. ft.	ITE(850)
Convenience market (24 hr.)	737.99	1000 sq. ft.	ITE (851)
Convenience market with gasoline pumps	845.6	1000 sq. ft.	ITE (853)
Gasoline/service station	168.56	Fueling Positions	ITE (844)
Warehouse	Ln(T) = 0.750 Ln(X) + 2.873	1000 sq. ft.	ITE(150)
Bank (with drive-through)	T = 174.529(X) + 385.789.181	1000 sq. ft.	ITE (912)
General office building	Ln(T) = 0.768 Ln(X) + 3.654	1000 sq. ft.	ITE (710)
Office park	T =10.422(X) + 409.04	1000 sq. ft.	ITE (750)
Government office building	68.9	1000 sq. ft.	ITE (730)
Government (civic center)	30	1000 sq. ft.	SANDAG [d]
Medical office building	T = 40.892(X) = 214.97.777	1000 sq. ft.	ITE (720)
Hospital	T = 10.411(X) + 1915.686	1000 sq. ft.	ITE (610)
Hospital	T = 7.38 (X) + 1718.324	Beds	ITE (610)
General light industry	T = 7.468(X) - 101.921	1000 sq. ft.	ITE (110)
General light industry	T = 42.223(X) + 263.112	Acre	ITE (110)
General light industry	T = 2.951(X) + 30.572	Employee	ITE (110)
General heavy industry	1.5	1000 sq. ft.	ITE (120)
General heavy industry	6.75	Acre	ITE (120)
Industrial park	T = 4.963(X) + 747.746	1000 sq. ft.	ITE (130)

Land Use	Trip-Generation Rate Fitted Curve Equation or Average Rate	X or Units [a]	Source [b]
Industrial park	T = 47.943(X) + 595.337	Acre	ITE (130)
Industrial park	Ln(T) = 0.796Ln(X) + 2.572	Employee	ITE (130)
Manufacturing	T = 3.881(X) – 20.702	1000 sq. ft.	ITE (140)

Notes:

T	=	average vehicle trip ends
sq. ft.	=	square feet
GLA	=	gross leasable area
N/A	=	data not available
SANDAG	=	San Diego Association of Governments

[a] "Dwelling unit" is a residential housing unit (including 'single-room occupancy' units and 'granny flats'). "Square feet" refers to the total floor area (on all levels) of buildings, but does not include parking structures even if they are within a building (also known as 'gross leasable area'). "Acres" refers to the gross surface of the entire site, including any structures, streets, sidewalks, parking, and landscaping (but not including building or parking lot floor areas above the first level).

[b] All trip-generation rates are from ITE, 6th edition, unless otherwise noted.

[c] Trip-generation rates are from ITE, 5th edition.

[d] Trip-generation rates are from SANDAG's San Diego Traffic Generators Manual (San Diego Association of Governments 1990).

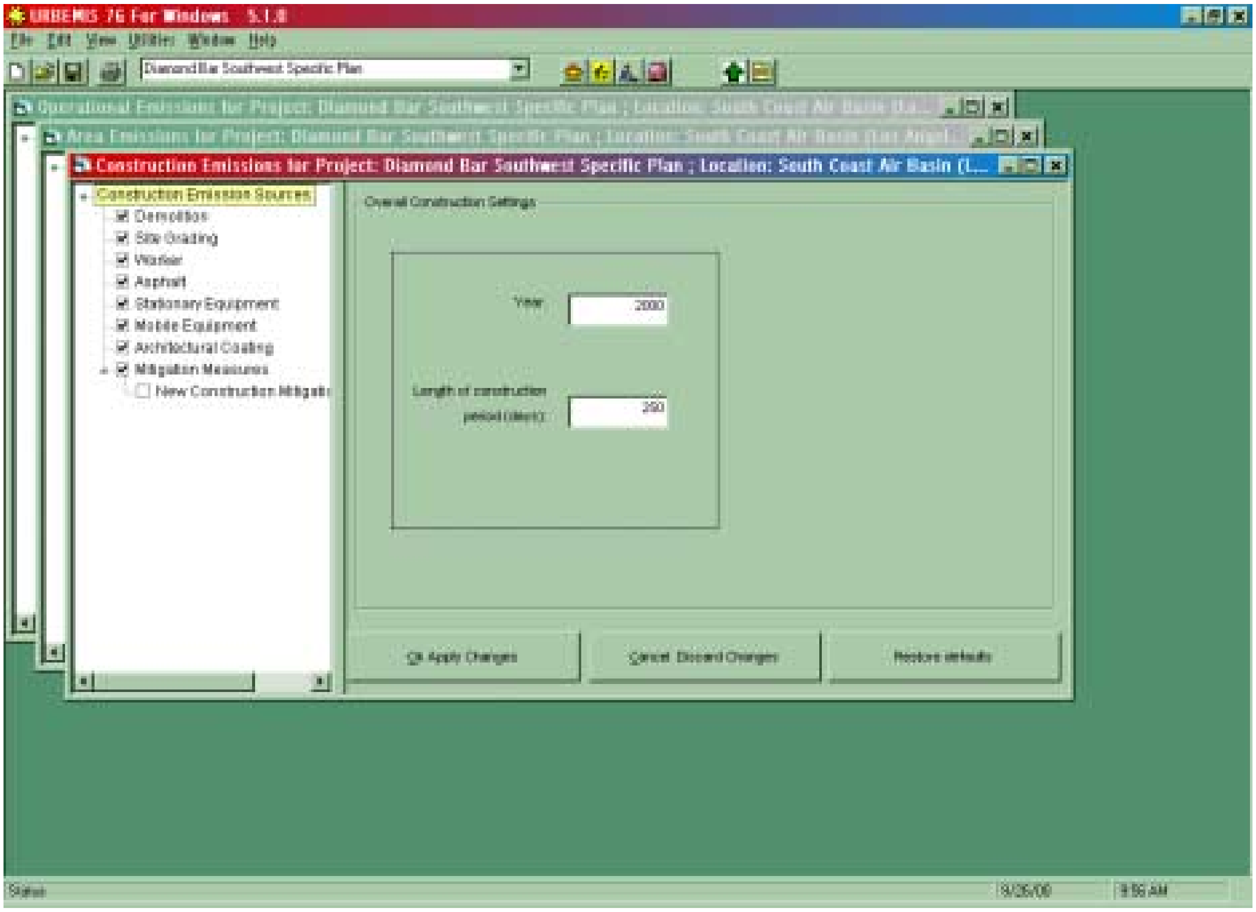
III.7 Construction Emissions

III.7.1 Specifying Construction Emissions

The construction emission screen allows the user to estimate area-source emissions for up to seven categories of emission sources: demolition, site grading (includes equipment exhaust and fugitive dust), worker commute trips, asphalt, stationary equipment, mobile equipment, and architectural coatings.

Figure 6 shows the introductory construction emissions screen. Please note that the screen or window is divided into left and right panes. A splitter bar separates the panes. By placing the cursor on the splitter bar and dragging right or left with the mouse, the relative size of each pane can be changed. This allows the user to see text that may be partially hidden. The cursor can also be placed on the edges of the window and dragged to change the size of the window. The left pane contains a list of items called "nodes".

Figure 6. Construction Emissions Entry Screen



For the construction window, each node in the left pane represents one of the seven construction-type categories. When the cursor is placed on one of the nodes and clicked, information associated with the associated category is shown in the right pane. To estimate construction emissions for a category, the user must ensure that the check box (in the left pane) associated with that category is checked.

Two construction categories—demolition and site grading—are often called “Phase I” emission sources. The remaining categories are often called “Phase II” emission sources. URBEMIS7G totals all construction emissions, but it does not total emissions separately by phase. The construction source main menu also allows the user to enter the year and length of construction period for which construction emissions are being estimated. The emission factors used by URBEMIS7G to estimate construction emissions are described in Appendix A.

From the first construction emission screen, the user clicks on a check box to see the respective emission estimate. When any construction category is selected, the category’s default assumptions are shown. Those assumptions can be edited by the user. For example, when the “Site Grading” box in the left pane is selected, the right pane changes to show the Site Grading Settings” default information. The site grading settings can then be modified and saved by clicking the "OK-Apply Changes" button. The user can also examine the components of site grading emissions, which include equipment exhaust and fugitive dust, by clicking on the appropriate tab, and a similar procedure can be used to review or modify the settings for each construction emission source. The user should note, however, that clicking the "OK-Apply Changes" button saves the information to memory, but not to a file (to save information to a file, see Section III.12).

Note that the settings for demolition require information to be entered in the "Demolition Emissions Settings" screen. If the demolition box is checked, indicating that the user wants to estimate demolition emissions, URBEMIS7G will indicate demolition emissions of zero unless information is provided on the total volume and maximum daily volume of the buildings to be demolished.

III.7.2 Specifying Construction-Related Mitigation Measures

From the construction emission sources menu, construction mitigation measures can be selected by selecting "Mitigation Measures" from the list in the left pane. URBEMIS7G then displays the first of two mitigation measure screens in the right pane. The user can access the second screen by clicking on the tab titled "Construction Mitigation – 2". The user has the option of checking one or more preprogrammed construction mitigation measures applicable to the current project.

The first preprogrammed screen allows the user to select mitigation measures for site grading and unpaved roads. The second allows the user to select mitigation measures for building construction (mobile equipment exhaust), worker commute trips, architectural coatings, and asphalt paving. The emission-reduction efficiencies assumed for each of the preprogrammed construction measures are shown in Table 3.

The user can also add up to 10 additional construction-source mitigation measures by selecting the "New Construction Mitigation Measures" from the list in the left pane. After making that selection, the "Additional Construction Mitigation Measures" screen is shown in the right pane. The user is required to enter the measure name, measure type, and percentage emission reduction for reactive organic gases (ROG), nitrogen oxides (NO_x), inhalable particulates (PM_{10}), and carbon monoxide (CO) for each measure to be added. The measure type is limited to one of eight construction emission types: site grading equipment, site grading dust, unpaved roads, mobile equipment exhaust, stationary equipment exhaust, construction worker trips, architectural coatings, and asphalt paving.

Table 3. Construction Emission Mitigation Measures

		Emission Reduction (%)				
Emission Source	**Mitigation Measure**	**ROG**	**NO_x**	**PM_{10}**	**CO**	**Source**
Site grading—equipment exhaust	Proper equipment maintenance	5.0	5.0	5.0	N/A	SMAQMD 1994
Site grading—active disturbance	Water exposed surface two times per day	-	-	37.0	N/A	SMAQMD 1994
Site grading—	Water exposed surface two	-	-	68.0	N/A	SMAQMD 1994

Emission Source	Mitigation Measure	Emission Reduction (%) ROG	NO_x	PM_{10}	CO	Source
active disturbance	times per day					
Site grading—active disturbance	Water exposed surface to keep soil moist at all times	-	-	75.0	N/A	SMAQMD 1994
Site grading—active disturbance	Apply nontoxic soil stabilizers to all inactive construction areas	-	-	65.0	-	SCAQMD 1993
Site grading—active disturbance	Replace ground cover in disturbed areas quickly	-	-	49.0	-	SCAQMD 1993
Unpaved roads	Water all haul roads two times per day	-	-	3.0	N/A	SMAQMD 1994
Unpaved roads	Water all haul roads three times per day	-	-	85.0	N/A	SCAQMD 1993
Unpaved roads	Pave all haul roads	-	-	92.5	N/A	SCAQMD 1993
Unpaved roads	Reduce speeds on all unpaved roads to 15 miles per hour or less	-	-	70.0	N/A	SCAQMD 1993
Stationary equipment	Proper equipment maintenance	5.0	5.0	5.0	N/A	SMAQMD 1994
Building construction—mobile equipment exhaust	Proper equipment maintenance	5.0	5.0	5.0	N/A	SMAQMD 1994
Building construction—mobile equipment exhaust	Use methanol or natural gas equipment instead of diesel	54.0	-29.0	95.0	25.0	SCAQMD 1993
Building construction—mobile equipment exhaust	Use propane or butane powered equipment instead of diesel	53.0	-53.0	18.0	96.0	SCAQMD 1993
Construction worker trips	Develop/implement trip reduction plan to achieve 1.5 AVR	2.2	2.9	2.9	2.9	SCAQMD 1993
Construction worker trips	Implement shuttle to and from retail establishments at lunch	1.0	1.3	1.3	1.3	SCAQMD 1993
Architectural coatings	Use coatings with VOC content less than compliance levels	5.0	-	-	-	no reference
Asphalt paving	Use asphalt with VOC content less than compliance levels	5.0	-	-	-	no reference

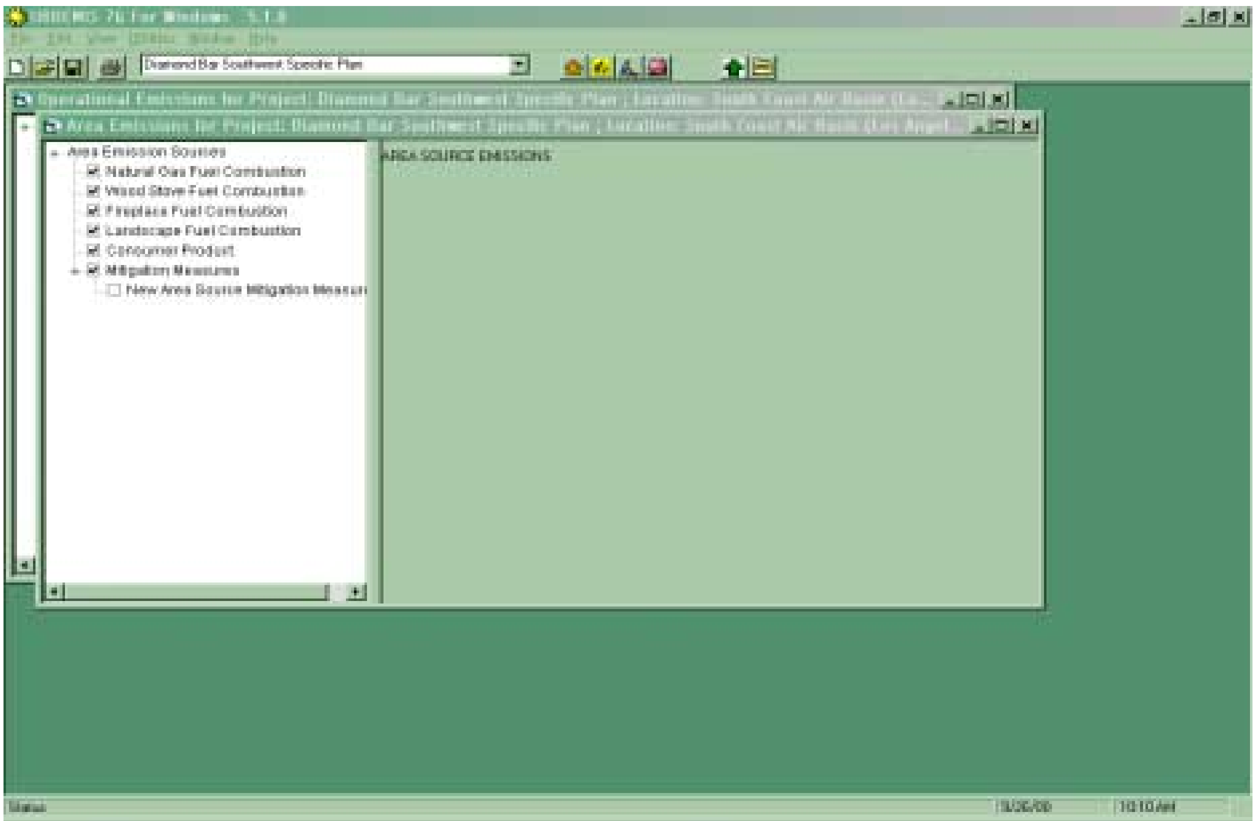
III.8 Area Source Emissions

III.8.1 Specifying Area Emissions

The "Area-Source Emission" screen allows the user to estimate area-source emissions for up to five categories of emission sources. Four categories are fuel combustion–related: natural gas, wood stoves, fireplaces, and landscape maintenance. The fifth, consumer products, includes only reactive organic compound emissions released by the use of products such as hair sprays and deodorants. The emission factors used by URBEMIS7G to estimate area-source emissions are described in Appendix B.

Figure 7 shows the introductory area-source emissions screen. Please note that the screen or window is divided into left and right panes. A splitter bar separates the panes. A splitter bar separates the panes. By placing the cursor on the splitter bar and dragging right or left with the mouse, the relative size of each pane can be changed. This allows the user to see text that may be partially hidden. The cursor can also be placed on the edges of the window and dragged to change the size of the window. The left pane contains a list of items called "nodes".

Figure 7. Area Source Entry Screen



Each area-source category is shown in the left pane, and information associated with each category is shown in the right pane. To examine the information associated with a category, the user must move the cursor to the applicable category in the left pane and click on that category. Associated information is then displayed in the right pane. Although this procedure can be used to examine information in the right pane, the user must check the box associated with each category for which emission estimates are desired.

When the user clicks on the "Natural Gas Fuel Combustion" settings button in the left pane, the right pane displays the "Natural Gas Combustion Settings" default information. The settings may then be modified, and saved by clicking on the "OK-Apply Changes" button. A similar procedure can be used to review or modify the settings for each area emission source. The user should note, however, that clicking the "OK-Apply Changes" button saves the information to memory, but not to a file (to save information to a file, see Section III.10.2).

The user should also note that the setting for fuel combustion-landscape maintenance requires the user to enter the year being analyzed. This year need not match the year entered for construction or motor vehicle emissions.

III.8.2 Specifying Area-Source Mitigation Measures

From the "Area Source" main menu, you may select area-source mitigation measures by clicking the "Mitigation Measures" checkbox in the left pane list. This action forces URBEMIS7G to display the preprogrammed area source mitigation measures in the right pane. The user can select a number of preprogrammed area-source mitigation measures for residential, commercial, and industrial sources. The efficiencies of the preprogrammed area source mitigation measures are shown in Table 4.

You can also add up to 10 additional area-source mitigation measures by selecting "New Area Source Mitigation Measures" from the left pane list. You are then shown the "Additional Area-Source Mitigation Measures" in the right pane, where you are required to enter, for each measure that you want to add, the measure name, measure type, and percentage emission reduction for ROG, NOx, PM10, and CO. The measure type is limited to one of seven types: residential space heating, residential water heating, residential landscape maintenance, commercial space heating, commercial water heating, commercial landscape maintenance, and industrial space heating.

Table 4. Area Source Emissions Mitigation Measures

		Emission Reduction (%)				
Emission Source	**Mitigation Measure**	**ROG**	**NO_x**	**PM_{10}**	**CO**	**Source**
Residential water heaters	Use solar or low-emission water heaters	11	9.5	4.5	10	SCAQMD 1993
Residential water heaters	Use central water heating systems	9	8	4	8.5	SCAQMD 1993
Residential heating	Orient buildings to the north for natural cooling and heating	14	13	10.5	13.5	SCAQMD 1993
Residential heating	Increase walls and attic insulation beyond Title 24 requirements	14	13	7.4	13	SCAQMD 1993
Commercial water heaters	Use solar or low-emission water heaters	0.5	0.5	0.5	0.5	SCAQMD 1993
Commercial water heaters	Use central water heating systems	0.5	0.5	0.5	0.5	SCAQMD 1993
Commercial heating	Orient buildings to the north for natural cooling and heating	11	13.5	17.5	12.5	SCAQMD 1993
Commercial heating	Increase walls and attic insulation beyond Title 24 requirements	10	9	7	9.5	SCAQMD 1993
Industrial heating	Orient buildings to the north for natural cooling and heating	2	3	2.5	5.5	SCAQMD 1993

Emission Source	Mitigation Measure	Emission Reduction (%)				Source
		ROG	NO_x	PM_{10}	CO	
Landscape maintenance—residential	Project provides electric maintenance equipment	100	100	100	100	no reference
Landscape Maintenance—Commercial	Project provides electric maintenance equipment	100	100	100	100	no reference

III.9 Vehicle-Source Emissions

III.9.1 Specifying Vehicle Emissions

Introduction

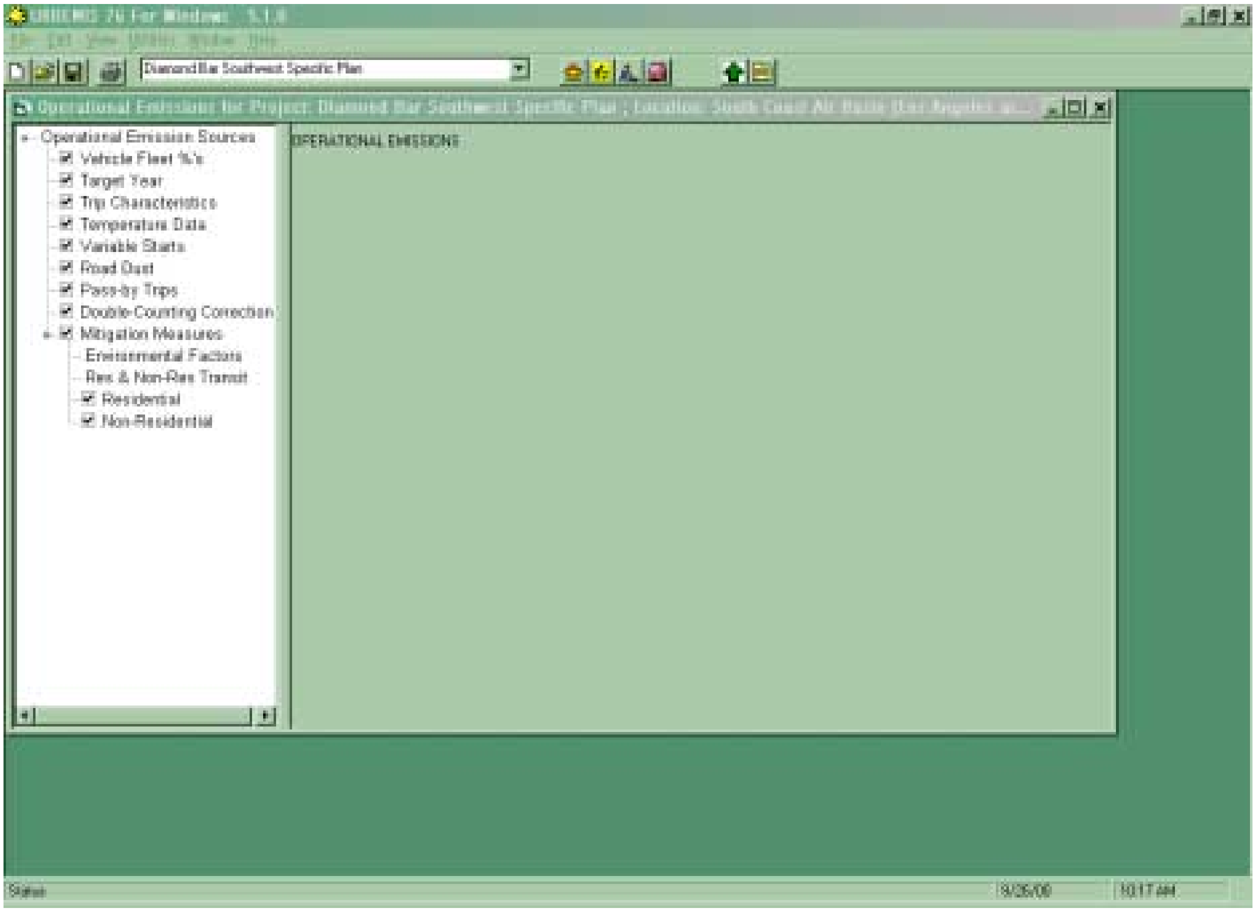
The "Settings for Operational-Related Emissions" entry screen in shown in Figure 8. Please note that the screen or window is divided into left and right panes. A splitter bar separates the panes. A splitter bar separates the panes. By placing the cursor on the splitter bar and dragging right or left with the mouse, the relative size of each pane can be changed. This allows the user to see text that may be partially hidden. The cursor can also be placed on the edges of the window and dragged to change the size of the window. The left pane contains a list of items called "nodes".

The left pane of Figure 8 shows eight separate nodes in the list (excluding the mitigation check boxes). Each node represents information needed to estimate motor vehicle emissions. The first five of these nodes (vehicle fleet percentages, target year, trip characteristics, temperature data, variable starts, and road dust) must be checked (they cannot be unchecked) to obtain motor vehicle emissions. The remaining three nodes (road dust, pass-by trips, and double counting) are optional and do not have to be checked to obtain motor vehicle emission estimates. The double counting node does not appear unless the user has indicated a mixed-use project by entering both a residential and a nonresidential land use in the land use selection screens.

Each operational vehicle category is shown as a node in the left pane; information corresponding to each category can be accessed by placing the cursor on the associated node and clicking, which forces URBEMIS7G to display the associated information in the right pane.

Note that neither the "Settings for Operational-Related Emissions" screen nor its supporting screens allow the user to specify the season (winter or summer) for which emissions will be estimated. URBEMIS7G automatically estimates motor vehicle emissions for winter and summer of the target year using the temperature data specified in the temperature data screen. The user can view or print summer or winter emission estimates in the output screens (see discussion under Section III.10).

Figure 8. Operational Emissions Entry Screen



Vehicle Fleet Percentages

The vehicle fleet percentages can be selected by clicking on the associated node in the left pane, which displays "Vehicle Fleet Characteristics" in the right pane. The user can modify any of the fleet percentages or fuel/technology classes in the right pane. Once the user is satisfied with the information, it can be saved to memory by clicking the "OK Apply Changes" button.

Target Year

The target year can be modified by clicking on the "Target Year Settings" box in the left pane, which will display the "Target Year" screen in the right pane. The user needs only click on the year for which emissions will be estimated. The right pane includes two buttons that allow the user to send the EMFAC7G emission tables for either the summer or winter season of the year selected to the printer. Clicking on the print button sends the emission table to the default printer. The EMFAC7G tables are large; consequently, they are printed in small font. Once the user selects the correct year, it can be saved to memory by clicking the "OK Apply Changes" button.

Trip Characteristics

The “Trip Characteristics” screen can be modified by clicking on the “Trip Characteristics Settings” node in the left pane. This action displays the trip characteristics in the right pane. Several pieces of information are contained in the “Trip Characteristics” screen: average trip speeds, trip percentages, and trip lengths for five different trip types (home-based work trips, home-based shopping trips, home-based other trips, work trips, and commercial-based non-work trips).

Please note that the “Trip Characteristics” screen allows the user to enter the trip percentages for home-based trips, which must total 100%. However, this screen does not permit the user to enter trip percentages for commercial-based trips. Instead, commercial-based percentages are calculated separately by URBEMIS7G for each nonresidential land use selected in the “Land Use” screens (see Section III.6).

The “% Worker Commute” information from the land use screens corresponds to the commercial-based commute work trip value. The commercial-based commute trip percentage is then used to estimate commercial-based noncommute work trip and customer-based trip percentages for each land use. If the commercial-based commute trip value exceeds 50%, the commercial-based noncommute trip percentage equals the difference between 100% and the commute trip percentage, multiplied by 50%. If the commercial-based commute trip value is less than 50%, the commercial-based noncommute trip percentage equals 50% of the commercial-based commute trip value. Finally, for each land use, customer based trips are assumed to equal the difference between 100% and the total of the commercial commute and noncommute percentages.

The “Trip Characteristics” screen also allows the user to modify default percentages for urban and rural trip lengths by trip type. The initial URBEMIS7G screen used to open an existing or new project contains a checkbox that allows the user to identify the project as being located in an urban or a rural setting. If the user identifies the project as urban, the urban trip lengths are used to estimate vehicle miles traveled and, ultimately, emissions. In contrast, if the user identifies the project as rural, the rural trip lengths are used. Once the user selects the correct year, it can be saved to memory by hitting the “OK Apply Changes” button.

Temperature Data

By clicking on the temperature data in the left pane, temperature options are presented in the right pane. The user can modify winter and summer ambient temperatures, which are used to estimate winter and summer emission estimates and correspond to the summer versus winter gasoline specifications used in California outside of the South Coast Air Basin (greater Los Angeles). Selecting “OK Apply Changes” from the “Temperature Data” screen saves the information to memory.

Variable Starts

The “Variable Starts” information can be modified by clicking on the “Variable Starts” settings button shown in the left pane, which causes URBEMIS7G to display variable starts information in the right pane. This screen includes information on “Variable Start Percentages by Trip Type and Time since Engine Stopped”. The information contained in this screen is new for URBEMIS7G and represents a significant change from previous versions of URBEMIS, corresponding to a change in ARB’s EMFAC emission factors. Previous versions of EMFAC (EMFAC7F1.1 and earlier) required that the percentages of cold and hot starts be provided. In contrast, EMFAC7G requires vehicle engine shut-off percentages for 12 time increments, ranging from 1–720 minutes. The information provided in this screen by trip type represents statewide averages of prestart cool-down profiles from an ARB analysis of the 1991 Caltrans household travel survey. These percentages should not be modified unless better information is available. Selecting “OK Apply Changes” from the “Temperature Data” screen saves the information to memory.

Road Dust

The Road Dust option can be turned on or off by clicking the checkbox in the left pane, which will also display information on “Entrained Road Dust Emissions” in the right pane. The user can modify the distribution of travel between paved and unpaved roads and can modify the paved road or unpaved road defaults by clicking on the accompanying tabs.

If the user clicks on the “Change Paved Road Defaults...” tab, the “Paved Road Dust Emissions” screen is displayed. From within that screen, the user can modify the default emission factors and percentage of travel for each of four road types.

The user can also click on the “Change Unpaved Road Defaults” tab, where URBEMIS7G will display the “Unpaved Road Dust Emissions” screen. From this screen, either the EPA methodology for calculating emissions or the ARB emission factor can be selected. If the EPA methodology is selected, one or more of the five variables used to estimate unpaved road dust emissions can be modified.

Double Counting

Another option available to URBEMIS7G users is to adjust for double counting, which is designed to reduce double counting of internal trips between residential and nonresidential land uses. Consequently, selecting this option is available only when both residential and nonresidential land uses have been selected. The user must click the check box in the left pane where URBEMIS7G displays the “Double Counting Correction”. URBEMIS7G then displays in the right pane a screen that asks which of two methods to use to adjust for double counting: direct input of the number of internal trips or program-generated estimate of internal trips.

If the former option, “Direct Input of the % of Total Trips, is selected, the user must click the corresponding tab, which will display the “Direct Input Double Counting Adjustment” screen.

At this screen, the user shown the number of residential and nonresidential trips that would be generated based on the selected land uses. The user is can enter the number of internal trips between residential and nonresidential land uses. The value entered represents the number of internal trips that will not be included in the emissions estimate. Once the user is comfortable with the internal trip estimate, clicking on the "OK/Return" button returns to the "Settings for Operational-Related Emissions" screen.

If you latter option, "Program-Generated Estimate of Internal Trips", is selected, URBEMIS7G displays the "Urbanized Context" screen. The user must then identify how the proposed project fits into its urbanized context to provide suggested default percentages. Once the desired percentages have been entered, clicking on the "OK – Apply Changes" button saves the information to memory.

Pass-by Trips

The "Pass-By Trips" button can be selected from the left pane. When "Pass-By Trips" is selected, however, no optional information is presented in the right pane. Selecting the "Pass-By Trips" button allows URBEMIS7G to calculate emissions from vehicle trips that are generally lower than estimates without the pass-by trip option. The pass-by trip algorithm is described in Appendix C.

III.9.2 Specifying Vehicle-Related Mitigation Measures

From the "Operational Emissions" screen, the user can turn operational mitigation measures on or off by clicking on the "Mitigation Measures" box in the left pane. If the user opts to estimate mitigated emissions, the user can select and edit any of four operational mitigation measure screens by clicking it in the left pane list. Those four options include environmental factors, regional and nonregional transit, residential, and nonresidential. Each option is described below.

Environmental Factors

The user can use either default environmental conditions and transit service or go through the list of environmental factors for pedestrian environment, transit service, and bicycle environment. The defaults are set at a level achievable by a standard suburban automobile-oriented subdivision or commercial development.

Once the user has selected the environmental conditions applicable to the project, the next step is to select appropriate mitigation measures. Such measures include residential, nonresidential, and transit mitigation measures, which applies to both residential and nonresidential land uses. The user should select all mitigation measures that are appropriate for the project from the groups of measures that are listed, which include measures to decrease single-occupant motor vehicle trips, such as transit measures, bicycle measures, and commute-trip measures.

URBEMIS7G adds the reductions from each category of measure, reduces the total based on the environmental factors, and presents this quantity in the final report. URBEMIS7G adds all reductions by measure types (i.e., transit, pedestrian, bike, and other) and then adjusts the amount by a correction factor to account for differences in effectiveness for different types of trips (i.e., H-W, H-S, H-O, W, N-W emp, N-W customer). A second correction factor adjusts the pedestrian and bicycle reductions to account for the shorter trips being replaced by these modes.

URBEMIS7G takes the adjusted trip-reduction percentages and reduces the trips generated by the URBEMIS7G trip-generation component. The new, lower trip-generation rate is then multiplied by the emission factors to calculate emissions. The program multiplies VMT reduced by the running-emission factor and then subtracts the amount from total emissions.

The program generates a report listing the environmental and transit service factors selected, mitigation measures selected, percent reductions for each mitigation type, and percent reduction for each trip type. The final results provide unmitigated project emissions, amount mitigated, and mitigated project emissions.

The vehicle-related mitigation measures component allows the user to calculate emission reductions achieved by applying mitigation measures to a project. To account for variability in effectiveness of mitigation measures resulting from environmental conditions, the program requires the user to set environmental factors affecting the measures. The percent reduction listed on the screen for each measure represents the maximum achievable under ideal conditions. The environmental factors reduce this amount in an internal calculation to arrive at the actual percent reduction.

The first screen encountered is the “Set Travel Mode Environment Screen”, which allows the user to select a default environment or to set the environment using a series of screens describing the conditions affecting travel in and around the project site. The default environment is based on an automobile-oriented suburban area without transit service. If the default environment is selected, the user is taken to the mitigation measure selection screens, which are described below. If the set environment option is selected, the user is taken to the “Pedestrian Environment Factor” screen.

From the “Pedestrian Environment Factor” (PEF) screens, the user must select from three coverage levels for seven different factors affecting pedestrian travel. Guidance for determining the coverage level for each factor is provided in the Mitigation Handbook. After a coverage level for each factor has been selected, URBEMIS7G adds the points selected and divides this number by the total points possible to arrive at the PEF. The program then takes the user to the “Transit Environment Factor” screen.

From the “Transit Environment Factor” screen, the user must select the highest level of transit service serving the project site. In some cases, this may be the planned level of service as indicated in an approved transit plan. Once the level of transit service has been selected, the user is taken to the “Bicycle Environment Factor” screen.

The “Bicycle Environment Factor” screens are similar to the PEF screens. The user must select from three possible levels of coverage corresponding to high, medium, or low for each of six different factors. Once the user has completed these screens, the user are taken to the mitigation measure selection screens.

The first mitigation measure selection screen is “Transit Enhancing Infrastructure Measures”, which is divided into two sections: Project Description Items and Developer Measures. Project Description Items are items that provide a benefit because of the project’s location or design. Developer Measures are physical improvements and infrastructure provided or funded by the developer; these are more traditional mitigation measures. The first possible selection is for the Project Description Item called “Project Density Meets Transit Level of Service Requirement”, which can be determined by comparing the current or planned level of transit service with the numbers in Tables D-3 and D-4 in Appendix D. The next selection is the Developer Measures that will be applied to the project. The program allows the user to include other mitigation measures not listed; however, the total percent reduction allowed may not exceed the predetermined maximum shown on the screen.

The next mitigation measure selection screen is “Pedestrian Enhancing Infrastructure Measures (Residential)”. If both residential and nonresidential land uses are selected on the first screen, the user will see separate screens for residential and nonresidential mitigation measures for enhancing pedestrian travel. The first user selection is a credit for “Mixed Use Project (Residential Oriented)” in the Project Description Items section. A definition of “Mixed Use” can be found in the Mitigation Handbook. Next, the user must select the Developer Measures that will be applied to the project from those listed, or new measures can be added.

The “Pedestrian Enhancing Infrastructure (Non-Residential)” screen includes Project Description Items for Mixed Use Project (Commercial) and for Floor Area Ratio (FAR) of 0.75 or greater. Project Description Measures can be selected and Developer Measures added as with the previous screens.

The “Bicycle Enhancing Infrastructure Measures” screens are next. No user-selected Project Description Measures are provided. Developer measures can be selected and new measures added as with the previous screens.

The next set of screens covers Operational Measures, which an employer or building owner would implement to reduce trips. The first set of measures applies to employee commute trips. The screens are designed differently than the infrastructure measure screens. Charging for parking has three levels from which to choose based on cost to the employee. The user can select the appropriate parking charge, or it can be skipped if free parking is provided. Measures for telecommuting and compressed work schedules require the user to enter the percent of the workforce participating in the program.

The next screen is for “Operational Measures (Applying to Employee Shopping Trips and Errands)”. All measures that will apply to the project should be selected. A measure for providing onsite shops and services allows three levels of credit based on the number of services provided at the worksite. The mitigation handbook contains guidance on making this selection.

The next screen is for "Operational Measures (Applying to Customer/Client Trips)." The user can select the customer parking charge that will apply to the site, if any, or add user measures as with previous screens.

The final set of screens applies to "Measures Reducing Vehicle Miles Traveled (VMT)" for nonresidential and residential projects. Provide the number of park-and-ride spaces or telecommuting workstations that will be provided by the developer. Any user measures added for these categories require the user to enter the VMT estimated to be reduced.

After the last mitigation measure screen is completed, the program returns the user to the "Set Travel Mode Environment" screen, where the user can accept the input, returning the user to the "Setting for Operational-Related Emissions", or revise the environment and mitigation settings. The program also allows the user to backtrack through the environment and mitigation screens to make changes by clicking the previous screen button.

III.10 Outputting Results

To view emissions output, the user must click on the far-right icon on the Icon Bar (the "Results" icon), which appears as a yellow sheet of paper with lines. Clicking on this icon will open the output or results report.

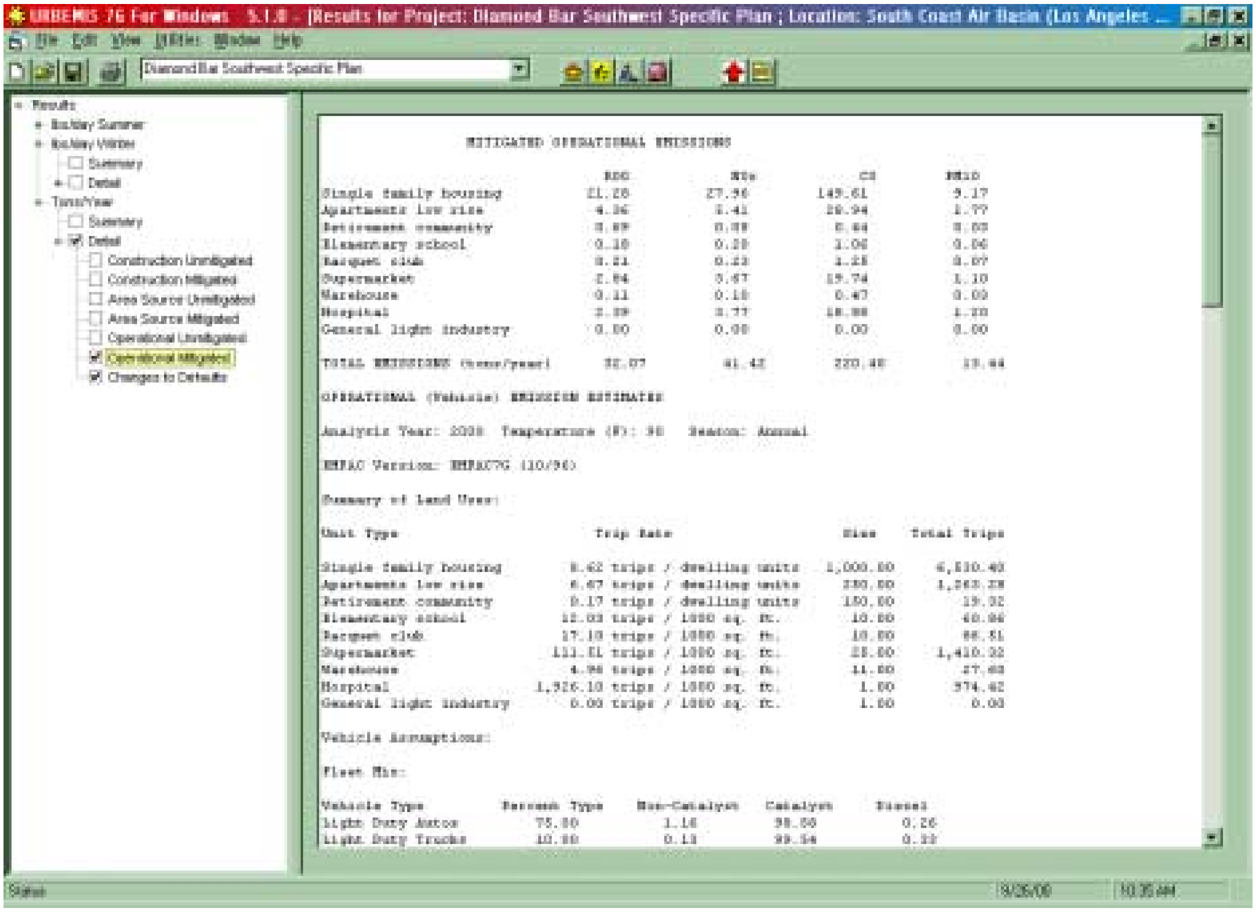
The results output is similar to the construction, area source, and operational screens in that the window is divided into left and right panes (Figure 9). The left pane contains an expandable or collapsible list, with each list item designated as a node.

When first opened, the results screen presents the user with three nodes in the left pane: pounds per day summer, pounds per day winter, and tons per year. By clicking on a node, the user can expand the list to display summary and detailed report nodes. The "Detail" node can be expanded further by clicking on either detail or the box to its left. Emission results for the current project can be displayed in the right pane by clicking the cursor on the desired node in the left pane. The check boxes associated with each node in the left pane identify the information sent to a printer or output file.

To send the output to the printer, the user can click on the printer icon, or select "File" from the Menu and "Print Selected Results" from its drop-down menu. If problems arise when printing, the print destination can be checked by selecting "File" from the Menu, then "Select Print Destination" from the drop-down menu.

The user can also send output to a file instead of printing, which is accomplished as follows. The user must first select "File" from the Menu, then the "Select Print Destination" from its drop-down menu. A screen then appears allowing the user to select a check box that sends the output to a ASCII file instead of the printer. By selecting that check box, however, all future print jobs are sent to the output file until "Select Print Destination" is selected by the user. Please note that this procedure tells URBEMIS7G that the print destination is to a file rather than to the printer. The information must still be sent to the printer by clicking on the printer icon, or by selecting "File" from the Menu and selecting "Print Selected Results" from its drop-down menu. URBEMIS7G will then ask for the name and location of the file to which output should be sent.

Figure 9. Output Emissions Screen



The user must be aware of one important fact about URBEMIS7G while running the program. When the results icon is selected, and the results screen is opened, the up arrow just to the left of the results icon appears red. A red up arrow indicates that the information in the results screens is based on the most recent changes made within URBEMIS7G and saved to memory. The user has the option of leaving the results screen open while making changes to land uses, construction, area sources, and vehicle default screens. When either of those screens is modified, the up arrow turns green. A green arrow indicates that the results shown do not reflect the most recent changes made by the User. Simply click the green arrow to update the results file, and the green arrow will turn red.

III.11 Setting Default Drives and Directories

Setting the correct default drives and directories is essential to running URBEMIS7G successfully. Four sets of files are included with URBEMIS7G: land-use project files, emission-rate files, air-district default files, and executable (.EXE) files.

At startup, the program looks for a file called DIRECTRY.SAV on the default drive. This file specifies the default drives and directories to URBEMIS7G. If URBEMIS7G finds the DIRECTRY.SAV file, the program loads the main menu. If URBEMIS7G cannot find the DIRECTRY.SAV file, however, the program immediately sends the user to the "Set Default Drives and Directories" screen.

Once there, the user is prompted to select a default drive and directory for each set of files. To select a default drive or directory, the user must position the cursor on the appropriate drive or directory and double click the left mouse button. Three sets of directories must be on the same drive for the program to run properly.

Once drives and directories have been selected, the user must either press "OK" or "Cancel". Pressing "OK" saves the newly selected drives and directories to the DIRECTRY.SAV file. Pressing "Cancel" returns the user to the main menu without saving any changes to the DIRECTRY.SAV file; "Cancel" will not work if the DIRECTRY.SAV file does not exist on disk in the default executable directory, which is the program from which URBEMIS7G is started.

III.12 Saving to a File

Saving the project file to a disk file is essential to rerun the program later. To save a file, select the "Save" icon (diskette icon) from the left side of the Icon Bar, or click on "File" from the Menu and select "Save This Project" from its drop-down menu. If a file with the same name already exists on the disk, URBEMIS7G will warn the user that a file with the same name already exists; the user can then opt to save the file as a different name. URBEMIS7G automatically gives files it creates a .URB extension.

III.13 Exiting the Program

The user cannot exit URBEMIS7G until all projects are closed. Open projects, in turn, cannot be closed until all forms have been closed. Once all projects have been closed, URBEMIS7G can be closed by either clicking on the "X" button in the top right-hand corner of the screen, or by selecting "File" from the Menu and selecting "Close this Project" from its drop-down menu.

IV. CITATIONS

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Appendix A. Construction Emissions

CONSTRUCTION EMISSIONS

URBEMIS7G allows construction emissions of inhalable particulate matter (PM_{10}), carbon monoxide (CO), reactive organic gases (ROGs), and oxides of nitrogen (NO_x) to be estimated. Construction emissions are estimated for:

- demolition emissions,
- site grading equipment exhaust and fugitive dust,
- construction worker vehicle trips,
- asphalt paving,
- stationary equipment,
- mobile equipment, and
- architectural coatings.

Demolition Emissions

If the user chooses to estimate construction emissions, the user will be prompted to select the types of construction emissions to be estimated. If the user selects demolition emissions, the user will be prompted to enter the total volume of buildings to be demolished and the maximum volume of buildings to be demolished in a single day. URBEMIS7G then calculates the total days required for completing demolition activities.

The following equation, based on Table A9-9-H of the South Coast Air Quality Management District's (SCAQMD's) California Environmental Quality Act (CEQA) Air Quality Handbook (South Coast Air Quality Management District 1993), is used to estimate daily PM_{10} generated by demolition:

$$PM_{10} \text{ (pounds per day)} = (0.00042 \text{ pound of } PM_{10} / \text{feet}^3) * (N * O * P) / Q$$

Where:

N = building width (feet)
O = building length (feet)
P = building height (feet)
Q = number of days required to demolish the building(s)

URBEMIS7G does not provide default information on building dimensions slated for demolition; the user must provide such information by entering building width, length, and height or total volume.

Site Grading Emissions

Grading Equipment Exhaust

Site grading emissions comprise two components: grading equipment exhaust and grading-related fugitive PM_{10} dust. Each component is described below.

The procedure used to estimate grading equipment exhaust emissions is based on emission factors developed by U.S. Environmental Protection Agency (1985). The mobile construction equipment equations proposed for URBEMIS7G are based on the following equation:

> *Emissions (pounds per day) = pounds of pollutant emitted per hour (from Table A-1) * hours per day for each equipment type operated*

Table A-1 summarizes the mobile construction equipment emission factors used by URBEMIS7G. For example, if construction involves use of a wheeled loader for 8 hours per day, PM_{10} emissions would total 1.36 pounds PM_{10} per day (0.17 pound of PM_{10} per hour * 8 hours per day).

As a default, URBEMIS7G assumes that one tracked loader, one wheeled loader, and one motor grader (all diesel-powered) are needed for each 10 acres of land disturbed (i.e., for any amount of land disturbance up to 10 acres, these pieces of equipment would each be used for 8 hours per day). If the project construction would disturb 11–20 acres, six pieces of equipment are assumed to be used (two of each type), each for 8 hours per day.

URBEMIS7G estimates a default acreage graded per day based on the land use sizes specified by the user. For single-family residential units, URBEMIS7G assumes five units per acre. For multifamily units, URBEMIS7G assumes 20 units per acre. For commercial uses, URBEMIS7G assumes that the acreage equals twice the size of each building's square footage. For example, URBEMIS7G assumes that a 100,000-square-foot industrial park would require 200,000 square feet (4.6 acres) of land disturbance. URBEMIS7G assumes that only 25% of total land acreage to be disturbed will actually be disturbed on the worst-case day. The user can modify the total acreage estimates generated by URBEMIS7G.

The user has the option of conducting more detailed estimates if additional construction information is available. By selecting the "Equipment Exhaust" option in the "Site Grading Emissions" menu, the user is prompted to specify the number of pieces of each equipment type shown in Table A-1 and the total hours per day that the equipment would be used. URBEMIS7G uses that information to provide daily emission estimates of ROG, NO_x, and PM_{10}. The user also is prompted to enter the number of days in which earthmoving would be conducted during the construction period; this information is used to estimate total annual emissions. URBEMIS7G defaults to 250 days if the user does not provide an estimate.

Fugitive Dust

The equation used to estimate fugitive dust PM_{10} emissions, shown below, is based on the emission factor prepared by the California Air Resources Board for construction activities.

*PM_{10} (pounds per day) = (220 pounds of PM_{10} / acre-month) * (month / 22 days) * (acres graded per day)*

The PM_{10} emission factor of 220 pounds per acre-month is based on a report prepared for the SCAQMD (Midwest Research Institute 1995). The acres graded per day is based on the same acreage estimates generated for estimating grading equipment exhaust. Annual emissions are estimated using the same number of days of construction activity that was used for estimating grading equipment exhaust. The user and the SCAQMD can modify each of the variables included in the fugitive dust equation.

Construction Worker Vehicle Trips

Emissions from construction worker vehicle trips are estimated by multiplying total daily employee vehicle miles traveled (VMT) by an emission rate (grams per mile). URBEMIS7G estimates construction-related employee trip generation as follows. Each land use type selected as part of the project is grouped into one of four general land use categories: multifamily, single-family, commercial/retail, and office/industrial. For each category, the number of trips is estimated using the following equations:

*Multifamily trips = 0.36 trip/unit * number of units*
*Single-family trips = 0.72 trip/unit * number of units*
*Commercial or retail trips = 0.32 trip/1,000 $feet^2$ * number of 1,000 $feet^2$*
*Office or industrial trips = 0.42 trip/1,000 $feet^2$ * number of 1,000 $feet^2$*

(These trip-generation rates are based on information contained in the Sacramento Metropolitan Air Quality Management District's [SMAQMD's] Air Quality Thresholds of Significance Handbook [Sacramento Metropolitan Air Quality Management District 1994].)

URBEMIS7G totals the trips from the four general land use categories and multiplies by the average trip length to obtain daily VMT. The user has the option of altering trip length. URBEMIS7G uses the construction year identified by the user in the "Settings for Construction-Related Emission" screen to select California Air Resources Board motor vehicle emission factor emission rates that will be multiplied by VMT per day. The length of the construction period is used to estimate annual Phase II construction emissions for construction worker vehicle trips, stationary equipment, and mobile equipment.

Asphalt Paving

URBEMIS7G estimates ROG emissions associated with asphalt paving using the procedure identified in the SMAQMD manual (Sacramento Metropolitan Air Quality Management District 1994). ROG emissions are estimated using the following formula:

*ROG (pounds per day) = (2.62 pounds ROG / acre) * (total acres paved / paving days)*

URBEMIS7G assumes that 50% of gross acreage identified in the grading dust emission estimates will be paved and that paving will take 10 days. The user can modify these assumptions by entering the number of acres to be paved and the number of days required to complete the paving.

Stationary Equipment

URBEMIS7G estimates stationary equipment construction emissions of ROG, NO_x, and PM_{10} from machinery such as generators. These estimates are based on the following equations:

*ROG (pounds per day) = 0.168 pound of ROG per unit (or thousands of feet^2) * number of units (or thousands of feet^2)*

*NO_x (pounds per day) = 0.137 pound of NO_x per unit (or thousands of feet^2) * number of units (or thousands of feet^2)*

*PM_{10} (pounds per day) = 0.008 pound of PM_{10} per unit (or thousands of feet^2) * number of units (or thousands of feet^2)*

These equations are based on the SMAQMD's manual and assume two pieces of gasoline-powered equipment per each 10 units or 10,000 feet^2. The equipment is assumed to be used 6 hours per day and averages 10 horsepower each (Sacramento Metropolitan Air Quality Management District 1995). The number of housing units and/or the square footage of building construction used to estimate stationary equipment emissions is based on the land use types entered by the user.

Mobile Equipment

The procedure used to estimate mobile equipment emissions is similar to that used for grading equipment exhaust emissions. The mobile construction equipment equations included in URBEMIS7G are based on the following equation.

*Emissions (pounds/day) = (pounds of pollutant emitted per hour) * (hours per day for each equipment type operated)*

Table A-1 summarizes the mobile construction equipment emission factors used by URBEMIS7G. URBEMIS7G estimates mobile equipment construction emissions of ROG, NO_x, and PM_{10} from mobile equipment such as forklifts and dump trucks.

As with the site grading equipment emissions, the number of housing units and/or the square footage of building construction is used to estimate the default amount of equipment used. As a default, URBEMIS7G assumes that two pieces of mobile equipment (one forklift and one dump truck) are used 8 hours per day for any amount of construction up to 10 units or 10,000 $feet^2$ (Sacramento Metropolitan Air Quality Management District 1994). The default amount of mobile source equipment is assumed to double for each doubling in the size of the land use. Thus, construction of from 11–20 units (10,001–20,000 $feet^2$) would require four pieces of construction equipment. It is assumed that the equipment is diesel-powered and used 8 hours per day.

Table A-1. Mobile Construction Equipment Emission Factors

	ROG (pounds/hour)		NO_x (pounds/hour)		PM_{10} (pounds/hour)	
Equipment Type	**Gas**	**Diesel**	**Gas**	**Diesel**	**Gas**	**Diesel**
Forklift (50 horsepower)	0.05	0.053	0.018	0.441	0.003	0.031
Forklift (175 horsepower)	1.53	0.17	0.92	1.54	0.123	0.093
Truck: off highway	--	0.19	--	4.17	--	0.26
Tracked loader	--	0.095	--	0.83	--	0.059
Tracked tractor	--	0.12	--	1.26	--	0.112
Scraper	--	0.27	--	3.84	--	0.41
Wheeled dozer	--	--	--	--	--	0.165
Wheeled loader	0.515	0.23	0.0518	1.9	0.03	0.17
Wheeled tractor	0.351	0.18	0.43	1.27	0.024	0.14
Roller	0.59	0.065	0.362	0.87	0.026	0.05
Motor grader	0.4	0.039	0.32	0.713	0.021	0.061
Miscellaneous	0.543	0.15	0.412	1.7	0.026	0.14

Sources: U.S. Environmental Protection Agency 1985, Sacramento Metropolitan Air Quality Management District 1995.

The user can conduct more detailed estimates if additional information is available. By selecting the Mobile Equipment Settings Diesel and/or Gas buttons, the user is prompted to specify the number of pieces of each equipment type shown in Table A-1 and the total hours per day that equipment would be used. URBEMIS7G uses that information to provide estimates of daily and annual ROG, NO_x and PM_{10} emissions.

Architectural Coatings

URBEMIS7G estimates ROG emissions resulting from the evaporation of solvents contained in paints, varnishes, primers, and other surface coatings. Separate procedures are used to estimate evaporative emissions from application of residential and nonresidential architectural coatings. The following emission factors are used for residential coating emissions:

> *ROG (pounds / day) = {[0.0185 pound of ROG per foot^2 surface area] * [(number of single-family units * square feet per unit) + (number of multifamily units * square feet per unit) * 2.7] * mil thickness} / {number of days + 3}*

The following equation is used for estimating nonresidential architectural coating emissions:

> *ROG (pounds/day) = {[(0.0185 pound ROG / foot^2 surface area) * (sum of individual building square footage * 2.0)] * mil thickness} / {number of days to paint + 3}*

For the residential equation, the factor 2.7 is used to convert building area to surface area. For nonresidential coatings, the factor 2.0 is used to convert building area to surface area. URBEMIS7G assumes that 20 days will be required to complete the painting and that drying takes an additional 3 days. URBEMIS7G also assumes that single-family homes average 1,800 feet^2 and multifamily homes average 850 feet^2. The number of units to be painted is based on land use information provided by the user.

The URBEMIS7G calculation assumes a ROG emission rate of 0.0185 pound of ROG per square foot, which represents a waterborne coating assumed to have 47.67% by weight solids, 10.54 pounds per gallon density, 250 grams per liter VOC content, and a coating thickness of 1 mil (0.001 inch).

The user has the option of altering the ROG emission rate, paint thickness, conversion ratio (building area to surface area), and the number of days required for completing the painting.

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Appendix B. Area Source Emissions

AREA SOURCE EMISSIONS

URBEMIS7G has been enhanced so that novice and experienced users can accurately estimate area source emissions. Novice users can generate estimates using default assumptions programmed into URBEMIS7G, and experienced users can modify the area source assumptions to suit a particular project.

URBEMIS7G allows the user to estimate area source emissions from:

- fuel-combustion emissions from space and water heating, including wood stoves and fireplaces;
- fuel combustion emissions from landscape-maintenance equipment; and
- consumer-product reactive organic gas (ROG) emissions.

Fuel Combustion Emissions from Water and Space Heating

Natural Gas Combustion

URBEMIS7G can be used to estimate fuel-combustion emissions from water and space heating using the approach described in Tables A9-12, A9-12-A, and A9-12-B in the South Coast Air Quality Management District California Environmental Quality Act handbook (South Coast Air Quality Management District 1993) and emission factors developed by the U.S. Environmental Protection Agency (EPA) (1995). With one exception (wood used for fireplaces and stoves), all emission estimates assume that natural gas is used as the primary source of water and space heating. The equation used to estimate carbon monoxide (CO), ROG, oxides of nitrogen (NO_x), and inhalable particulate matter (PM_{10}) emissions from natural-gas combustion for each land use type is as follows:

*Emissions = H * [(F * G / 30) / 1,000,000] * P*

Where:

H = emission factor for each criteria pollutant (pounds of pollutant per million cubic feet of natural gas consumed):
CO: 40
ROG: 7.26
NO_x: 94.0 (residential)
NO_x: 100.0 (nonresidential)
PM_{10}: 0.18

F = units per land use type:
residential: number of units
industrial: customers
hotel/retail/office: square feet

G = natural gas usage rates:
residential:
single-family: 6,665.0 feet^3 / unit / month
multifamily: 4,011.5 feet^3 / unit / month
nonresidential:
industrial: 241,611 feet^3 / customer / month
hotel/motel: 4.8 feet^3 / square feet / month
retail/shopping: 2.9 feet^3 / square feet / month
office: 2.0 feet^3 / square feet / month

P = percent using natural gas:
residential: 100%
nonresidential: 100%

Wood Combustion (Wood Stoves)

Wood stove emissions can be estimated using the following equation:

*Wood Stove Emissions (pounds per day) = [(A * C) + (B * D) + (E * F) + (J * K)] * G * (H * I)*

Where:

A = EPA-certified noncatalytic stove emission rate (grams of pollutant per ton of kilogram wood burned)

B = EPA-certified catalytic stove emission rate (grams of pollutant per kilogram of wood burned)

C = percent of all stoves assumed to be noncatalytic

D = percent of all stoves assumed to be catalytic

E = conventional wood stove emission rate (grams of pollutant per kilogram of wood)

F = percent of all stoves assumed to be conventional

G = cords of wood burned per year per residential unit

H = number of residential units

I = percent of residential units with wood stoves

J = pellet stove emission rate (grams of pollutant per kilogram of wood burned)

K = percent of all stoves assumed to be pellet

URBEMIS7G assumes the following defaults for wood stove emissions:

A = 9.8 grams PM_{10} / kilogram, 70.4 grams CO / kilogram, 7.5 grams ROG / kilogram, 1.4 grams NO_x / kilogram

B = 10.2 grams PM_{10} / kilogram, 52.2 grams CO / kilogram, 7.8 grams ROG / kilogram, 1.0 gram NO_x / kilogram

C = 50% (entered as 0.50)

D = 50% (entered as 0.50)

E = 15.3 grams PM_{10} / kilogram, 115.4 grams CO / kilogram, 21.9 grams ROG / kilogram, 1.4 grams NO_x / kilogram

F = 0.0%

G = 1.48 cords per year per residential unit

H = based on land uses specified by the user

I = 35% (entered as 0.35)

J = 2.1 grams PM_{10} / kilogram, 19.7 grams CO / kilogram, 0.01 gram ROG / kilogram, 6.9 grams NO_x / kilogram

K = 0.0%

The emission factors shown above are based on the EPA's AP-42 document (U.S. Environmental Protection Agency 1995). The emission factor assumes an even division among noncatalytic, catalytic, and pellet stoves. The default assumption assumes that no conventional stoves will be included, although the equation will allow the user to include conventional stoves in the emission calculation. Annual emissions assume that 2.71 tons (1.48 cords) of wood would be burned per stove per residential unit during the heating season.

Wood Combustion (Fireplaces)

Fireplace emissions are estimated using the following equation:

*Fireplace emissions (pounds per day) = (J * K * L * M)*

Where:

J = fireplace emission rate (pounds of pollutant per residential unit per ton of wood burned)

K = cords of wood burned per day year per residential unit

L = number of residential units

M = percent of residential units with wood stoves

URBEMIS7G will assume the following defaults for fireplace emissions:

J = 34.6 pounds of PM_{10} / ton, 252.6 pounds of CO / ton, 229.0 pounds of ROG / ton, 2.6 pounds of NO_x / ton

K = 1.48 cords burned per year per residential unit

L = residential units are based on the residential land uses specified by the user

M = 10% (entered as 0.10)

These emission rates are based on information published by the EPA (1995). As with wood stove emissions, the user can modify each variable used to estimate fireplace emissions. Annual emissions are estimated based on annual wood combustion.

Fuel Combustion Emissions from Landscape Maintenance Equipment

Landscape-maintenance equipment generates emissions from fuel combustion and from evaporation of unburned fuel. Emissions include NO_x, ROG, CO, and PM_{10}. Equipment in this category includes lawn mowers, roto tillers, shredders/grinders, blowers, trimmers, chain saws, and hedge trimmers used in residential and commercial applications. This category also includes air compressors, generators, and pumps used primarily in commercial applications (California Air Resources Board 1992a).

The California Air Resources Board (ARB) has enacted regulations to limit emissions from landscape-maintenance equipment (California Air Resources Board 1992b). Beginning in 1994, these regulations impose emission limits on all landscape-maintenance equipment sold. These regulations become more stringent for equipment sold in 1999 and later. Consequently, the emissions from this source category are similar to automobile emissions in that the turnover in the equipment fleet plays an important part in the rate of emission reductions.

URBEMIS7G estimates emissions from this source category based on the year in which the user is attempting to estimate emissions. The ARB prepared emission estimates in 1989 and has proposed emission reductions expected by 2010. The proposed equations for this source category are divided into residential and commercial categories. The residential equation applies only to single-family housing units (SFHUs). The commercial equation is based on emissions per business unit and includes multifamily residential land uses.

Table B-1. Proposed Equations for Landscape-Maintenance Equipment Emission Estimates

	1989 Emissions		2010 Emissions	
	Residential	**Commercial**	**Residential**	**Commercial**
ROG	0.003 pound ROG/ SFHU/day * SFHU	0.175 pound ROG/ business unit * number business units	0.00054 pound ROG/ SFHU/day * SFHU	0.175 pound ROG/ business unit * number business units
CO	0.024 pound CO/ SFHU/day * SFHU	1.149 pound CO/ business unit * number business units	0.00576 pound CO/ SFHU/day * SFHU	1.149 pounds CO/ business unit * number business units
NO_x	0.0002 pound NO_X/ SFHU/day * SFHU	0.007 pounds NO_X/ business unit * number business units	0.00014 pound NO_X/ SFHU/day * SFHU	0.007 pound NO_X/ business unit * number business units
PM_{10}	0.00006 pound PM_{10}/ SFHU/day * SFHU	0.0041 pound PM_{10}/ business unit * number business units	0.000005 pound PM_{10}/ SFHU/day * SFHU	0.0041 pound PM_{10}/ business unit * number business units

The residential emission factors shown in the 1989 emission equations are based on total residential emissions from this source category in San Joaquin Valley divided by the San Joaquin Valley's total 1989 SFHUs. Similarly, the commercial emission factors for 1989 are based on total San Joaquin Valley commercial emissions divided by the valley's total 1989 business units (U.S. Department of Commerce 1991). For the commercial equations, URBEMIS7G bases the number of business units on the number of non single-family housing land uses specified by the user.

The 2010 emission rates are based on the ARB's estimates that, by 2010, the regulation will reduce ROG emissions by 82%, CO by 76%, PM_{10} by 91%, and NO_x by 28%.

The regulations for this source category take effect in 1994 and become more stringent in 1999. URBEMIS7G will use the emission rates shown for 1989 for 1990–1993. For 1994–2009, URBEMIS7G will use interpolated emission factors by assuming a uniform decrease in the emission rate each year. In 2010 and succeeding years, the 2010 emission rates will be used.

Average annual emissions assume that daily emissions would occur only during the 180-day summer period. The end user will be able to modify the length of the summer period.

Consumer-Product Reactive Organic Gas Emissions

Consumer product emissions are generated by a wide range of product categories, including air fresheners, automotive products, household cleaners, and personal care products. Emissions associated with these products primarily depend on the increased population associated with residential development (California Air Resources Board 1990). Consequently, URBEMIS7G can be used to estimate consumer product emissions when one or more residential land uses have been selected by the user. Emissions would be based on the following equation:

*ROG (pounds/day) = 0.0171 pound of ROG per person * number of residential units * 2.861 persons per unit*

The ROG emission factor is based on the total estimated ROG emissions from consumer products divided by the total California population (California Air Resources Board 1990; California Department of Finance 1994). Persons per household is based on the 1990 U.S. census information for California (California Department of Finance 1994).

URBEMIS7G will base the number of residential units on information provided by the user on residential land uses. The user can modify each of the variables in the ROG emissions equation.

Annual emissions are estimated by multiplying pounds of ROG emitted per day by 365 days (1 year).

CITATIONS

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Appendix C. Operational (Motor Vehicle) Emissions

EXHAUST EMISSION FACTORS

URBEMIS7G estimates vehicle exhaust emissions using several pieces of input supplied by the user. That information is entered in the series of operational emission screens incorporated into URBEMIS7G. URBEMIS7G then calls the appropriate summer and winter EMFAC7G files based on the analysis year selected by the user.

Based on information supplied by the user, URBEMIS7G selectively reads portions of the EMFAC7G file. After the EMFAC7G file has been read, URBEMIS7G calculates criteria pollutant emissions for:

- running exhaust (grams of reactive organic gases [ROG], carbon monoxide [CO], oxides of nitrogen [NO_x], and inhalable particulate matter [PM_{10}] per mile),
- tire wear particulates (grams of PM_{10} per mile),
- brake wear particulates (grams of PM_{10} per mile),
- variable starts (grams of ROG, CO, and NO_x per trip),
- hot soaks (grams of ROG per trip),
- diurnals (grams of ROG per hour) ,
- resting losses (grams of ROG per hour), and
- evaporative running losses (grams of ROG per mile).

Two of these emission categories, running exhaust and variable starts, are also adjusted by a temperature correction factor included as part of EMFAC7G. Once emission rates have been obtained from EMFAC7G and corrected, URBEMIS7G generates estimates for other key data needed to estimate emissions, such as miles traveled, number of trips, or number of hours. This key data are then multiplied by the appropriate emission factors, adjusted to obtain the correct units (pounds per day and tons per year), and sent to a temporary file that can be viewed by the user.

Entrained Road Dust Emissions

Entrained road dust emissions are generated by vehicles traveling on paved or unpaved roads. URBEMIS7G provides users with a default percentage of vehicle miles traveled (VMT) for paved versus unpaved roads. Users are asked if they want to modify those percentages. Default percentages assume that 100% of VMT occurs on paved roads and 0% on unpaved roads.

Paved Roads

For paved roads, URBEMIS7G uses the following equation:

*PAVED = [(LOCAL * LOCPER) + (COLLECT * COLPER) + (MAJOR * MAJPER) + (FREEWAY * FREEPER)] * [VMT * PAVEPER]*

Where:

LOCAL = PM_{10} emission factor for local streets (0.018 pound / VMT)
LOCPER = percentage of travel on local streets
COLLECT = PM_{10} emission factor for collector streets (0.013 pound / VMT)
COLPER = percentage of travel on collector streets
MAJOR = PM_{10} emission factor for major streets/highways (0.0064 pound / VMT)
MAJPER = percentage of travel on major streets
FREEWAY = PM_{10} emission factor for freeways/expressways (0.00067 pound / VMT)
FREEPER = percentage of travel on freeways
VMT = total vehicle miles traveled
PAVEPER = percent of VMT on paved roads (default equals 100)

URBEMIS7G is programmed to ensure that LOCPER, COLPER, MAJPER, and FREEPER total 100% and that PAVEPER and UNPAVEPER also total 100%. The default percentages equal 0.129 for LOCPER, 0.119 for COLPER, 0.500 for MAJPER, and 0.252 for FREEPER, based on 1993 travel fractions for California (California Air Resources Board 1997).

This equation is based on the recommended particulate emission factors for specific roadway categories found in AP-42 (U.S. Environmental Protection Agency 1995). The user can modify the five percentages shown in the equation.

Unpaved Roads

The unpaved road equation is as follows:

$$UNPVD = [PSDUNP * 5.9 *(UNSILT / 12.0) * (SPD / 30.0) * (WEIGHT / 3.0)^{0.7} * (VWHEEL / 4.)^{0.5} * (365 - IPDAYS) / 365] * [VMT * UNPAVEPER]$$

Where:

UNPVD = fleet average unpaved road dust emissions (pounds/day)
PSDUNP = fraction of particles less than or equal to the particle size cutoff
UNSILT = percent silt content of the surface material (input by the user)
SPD = average vehicle speed (miles per hour, input by the user)
WEIGHT = fleet average vehicle weight (tons, input by the user in lbs.)
VWHEEL = fleet average number of wheels (input by the user)
IPDAYS = average days per year with greater than 0.01 inch of rain (input by the user)

VMT = total vehicle miles traveled per day
UNPAVEPER = percentage of VMT on unpaved roads

This equation is based on the U.S. Environmental Protection Agency's emission factor equation for unpaved roads (U.S. Environmental Protection Agency 1995).

PSDUP = 0.36 (for the 10 microns and under particle size cutoff)
UNSILT = 4.3% (allowable range [4.3–20%])
SPD = 40 miles per hour (allowable range [13–40 mph])
WEIGHT = 3 tons (allowable range [3–157 tons])
VWHEEL = 4 wheels (allowable range [4–13 wheels])
IPDAYS = 0 days rain for worst-case day, 40 days per year of annual estimate
VMT = generated by URBEMIS
UNPAVEPER = 0.0

The user will be allowed to modify all values except PSDUP. Annual emissions would be estimated by multiplying daily emissions by 365 days (1 year).

Minimize Double Counting for Multiuse Projects and Pass-By Trips

This discussion is divided into two sections: double counting of multiuse projects and double counting of pass-by and diverted link trips.

Double Counting of Multiuse Projects

URBEMIS7G contains a procedure that reduces double counting of internal trips in a mixed-use project or community plan area. The procedure only applies when at least one residential and one nonresidential land use are specified by the URBEMIS7G user and the user selects the double-counting correction algorithm.

Because trip-generation rates account for both trip production and attraction, adding the gross trip generation for two land uses in a project double counts the trips between them. The procedure described below is designed to count the internal trips only once.

The user can select either the direct input of the percentage of internal trips or a program-generated estimate of internal trips. If the user selects the direct input approach, URBEMIS7G displays a screen showing the number of residential and nonresidential trips. Then the user is prompted to enter the gross internal trip number, which limits the number of internal trips estimated by URBEMIS7G.

The gross internal trip limit reported by the program is based on a comparison of residential trips versus nonresidential trips; the smaller of the two is the limiting value.

Alternatively, the user selects the program-generated estimate of internal trips. Under this option, the user is first asked to identify the project site in relation to its urbanized context. Suggested default percentages for internal trips by trip purpose are determined by the urbanization context of the project. Usually, the suggested default percentage for work trips is lower than the suggested default percentage for shopping and other trips. The suggested defaults for a major component of a metropolitan area are higher than the suggested defaults for a minor component of a metropolitan area. If the urbanization context of the project is an isolated rural development, the suggested defaults equal 100%. Please note that unless residential and nonresidential land uses are perfectly balanced in gross trip generation, there will always be some external trips in the final program computations.

URBEMIS7G uses the defaults listed below in Table B-1 for performing the double counting adjustment:

Table C-1. Defaults for Double Counting Adjustment

	Percentages		
Isolated Trip Type	**Isolated Development**	**Minor Component**	**Major Component**
Residential			
Home-work	100	10	30
Home-shop	100	20	50
Home-other	100	20	50
Nonresidential			
Work	100	10	30
Nonwork	100	20	50

As presented above, the proposed double-counting correction is applied only to trips between residential and nonresidential land uses. A small amount of double counting may remain for trips between different residential land uses.

Based on the user's response, URBEMIS7G presents information internal trip limits based on trip types and prompts the user to estimate the percentage of those trips that are internal to the project (i.e., the percentage that is double counted).

The internal trip double-counting correction procedure is based on the selected land use categories and associated trip-generation rates. Residential trips by trip purpose are compared with nonresidential trips by trip purpose to establish limits on the internal trip adjustments.

Once information has been entered in URBEMIS7G, total trips are adjusted by the following formula:

*Net trips = gross total trips - (0.5 * gross internal trips)*

This equation can also be presented as follows:

Net trips = external trips + net internal trips

Where:

External trips = gross total trips - gross internal trips
*Net internal trips = (0.5 * gross internal trips)*

Double Counting of Pass-By Trips

An important deficiency in URBEMIS5 was that it did not account for pass-by trips and diverted linked trips. According to the Institute of Transportation Engineers' (ITE's) document Trip Generation, 5th Edition (Institute of Transportation Engineers 1991), vehicle trips associated with a trip generator can be divided into three categories:

- *Primary Trips* are trips made for the specific purpose of visiting the generator. The stop at that generator is the primary reason for the trip. For example, a home to shopping to home combination of trips is a primary trip set.

- *Pass-By Trips* are trips made as intermediate stops on the way from an origin to a primary trip destination. Pass-by trips are attracted from traffic passing the site on an adjacent street that contains direct access to the generator. These trips do not require a diversion from another roadway.

- *Diverted Linked Trips* are trips attracted from the traffic volume on roadways within the vicinity of the generator but which require a diversion from that roadway to another roadway to gain access to the site. These roadways could include streets or freeways adjacent to the generator, but without access to the generator.

In calculating the emissions associated with a project, the distinction between these three categories of trips is important. Pass-by and diverted linked trips associated with a project generate substantially lower levels of net emissions than a primary trip.

For air quality impact analysis, the major difference between a pass-by trip and a diverted linked trip is the added vehicle miles traveled associated with the diverted linked trip. Pass-by trips, by definition, do not require a diversion from the original trip route. Conversely, diverted linked trips do involve diversion from the original trip route. A major difficulty in estimating the additional travel associated with a diverted linked trip is that the amount of additional travel is sensitive to local site factors. In particular, the distance from the project site to major arterials or freeways strongly influences the amount of additional travel.

Pass-by and diverted linked trips are most important for retail commercial land uses. As an example of how important these trips are, the February 1995 update to the ITE's Trip Generation, 5th Edition, notes that an average of 87% of trips made to gasoline stations in the p.m. peak hour are pass-by and diverted linked trips. Not accounting for pass-by and diverted linked trips substantially overstates the amount of indirect source emissions associated with a proposed gasoline station.

URBEMIS7G has an option that allows the user to account for pass-by and diverted linked trips. The primary data sources for appropriate pass-by and diverted linked trip adjustments are the ITE's Trip Generation, 5th Edition, and the February 1995 update (Institute of Transportation Engineers 1991, 1995). The San Diego Association of Governments (SANDAG) has also produced a document that includes estimates of pass-by and diverted linked trips for specific land uses (San Diego Association of Governments 1990). These three documents present pass-by and diverted linked trip values as a percentage of total trips for several land use categories. One distinction between the ITE versus SANDAG estimates is that for pass-by trips, SANDAG assumes that any diversion requiring an additional 1 mile or less is a pass-by trip. In contrast, ITE assumes that any diversion off of the intended travel route is a diverted linked trip.

Table C-2 shows estimates of pass-by and diverted linked trip percentages using data contained in ITE's Trip Generation, 5th Edition, the February 1995 update to the 5th edition, and the SANDAG report (Institute of Transportation Engineers 1991, 1995; San Diego Association of Governments 1990). The ITE and SANDAG trip generation data primarily describe peak-hour versus average daily conditions. Jones & Stokes has developed average daily percentages of primary trips, diverted linked trips and pass-by trips associated with each land use for the URBEMIS7G model.

When the pass-by trip correction algorithm is selected by the user, URBEMIS7G adjusts trip end emissions (i.e., cold start, hot start, and hot soak) associated with pass-by and diverted linked trips

For traffic impact analyses, pass-by trips are generally eliminated from consideration; they have no net effect on traffic volumes. Similarly, diverted linked trips may have a minimal effect on traffic volumes. Conversely, pass-by and diverted linked trips may have a substantial effect on air quality, and this effect may increase in the future as trip-end emissions become a larger portion of total vehicle trip emissions. A pass-by or diverted linked trip associated with a shopping center is a good example of how these trips can affect air quality. Such a trip would have little or no net effect on traffic volumes. However, if the shopper stays at the shopping center for 1 hour, a substantial portion of a hot soak episode would occur and, for a catalytic converter-equipped vehicle, the trip leaving the shopping center would begin in a cold-start mode.

URBEMIS7G estimates trip end emissions associated with pass-by and diverted linked trips and additional travel associated with diverted linked trips. Jones & Stokes has modified URBEMIS7G so that it makes separate emission estimates for primary trips, pass-by trips, and diverted linked trips.

For primary trips, the emission estimating procedure does not change except that the trip-generation rate for each land use would be multiplied by that land use's primary trip percentage shown in Table C-2.

For pass-by trips, the trip-generation rate for each land use is multiplied by that land use's pass-by trip percentage shown in Table C-2. In addition, the trip length for each trip type (e.g., homework, home-shop) is set to 0.01 mile. The change in trip length reflects the pass-by trip definition in that these trips result in virtually no additional travel. However, emissions associated with pass-by trips still occur. Consequently, the hot and cold start percentages are increased by 10% to reflect additional emissions from these operating modes.

For diverted linked trips, the trip generation rate for each land use is multiplied by that land use's diverted linked trip percentage shown in Table C-2. The trip length is also adjusted downward to equal 25% of the primary trip length for each trip type. By doing so, it accounts for the additional travel associated with diverted linked trips. Also, the hot and cold start percentages for each trip type are increased by 10% to reflect additional emissions from these operating modes.

Method for Calculating Default Trip Lengths from Travel Survey Data

Trip lengths are one of the most important data elements used in calculating project emissions. Air districts or other agencies responsible environmental review should ensure that default trip length values used in their area have a sound basis. Unfortunately, the data most readily available from regional travel models for this purpose are typically formatted differently than the data used in URBEMIS. This section provides a method for converting available data for use as URBEMIS7G defaults.

One source of data is the Caltrans Statewide Travel Survey. The most recent version was published in 1991. The data are stratified by trip purpose. The trip categories are home to work (H-W), home to shop (H-S), home to other (H-O), other to work (O-W), and other to other (O-O). The survey provides trip lengths for only H-W and total trips. More detailed breakdowns may be available from the Regional Transportation Planning Agency (RTPA) in user's area. The survey and most RTPA models provide trip lengths in terms of minutes. The average speed is used to convert minutes to miles.

Table C-2. Primary, Pass-By, and Diverted Linked Trip Percentages

	Recommended Percentages			Available Data		
Land Use	**Primary Trip**	**Diverted Linked Trip**	**Pass-By Trip**	**Source**	**Trip Categories (Primary/Diverted/ Pass-By)**	**Time Period**
Single-family housing	90	10	0	San Diego [a]	86/11/3	daily
Apartment (low rise)	90	10	0	San Diego [a]	86/11/3	daily
Apartment (high rise)	90	10	0	San Diego [a]	86/11/3	daily
Condominium/townhouse (general)	90	10	0	San Diego [a]	86/11/3	daily
Condominium/townhouse (high rise)	90	10	0	San Diego [a]	86/11/3	daily
Mobile home park	90	10	0	San Diego [a]	86/11/3	daily
Retirement community	90	10	0	San Diego [a]	86/11/3	daily

Land Use	Recommended Percentages: Primary Trip	Recommended Percentages: Diverted Linked Trip	Recommended Percentages: Pass-By Trip	Available Data: Source	Available Data: Trip Categories (Primary/Diverted/ Pass-By)	Available Data: Time Period
Elementary school	60	40	0	San Diego [a]	57/25/10	daily
High school	75	25	0	San Diego [a]	75/19/6	daily
Church	75	25	0	San Diego [a]	64/25/11	daily
Racquet club	50	50	0	—	N/A	—
Racquetball/health club	50	50	0	—	N/A	—
Day-care center	25	75	0	San Diego [a]	28/58/14	daily
Quality restaurant	60	30	10	—	N/A	—
High-turnover (sit-down) restaurant	30	40	30	ITE update	28/32/40	p.m. peak
Fast-food restaurant (no drive-through window)	30	35	35	—	N/A	—
Hotel	70	30	0	San Diego [a]	58/38/4	daily
Motel	70	30	0	San Diego [a]	58/38/4	daily
Free-standing discount store	45	45	10	San Diego [a]	45/40/15	daily
Regional shopping center (>570,000-square-foot GLA [c])	55	25	20	ITE	Varies	daily
Regional shopping center (<570,000-square-foot GLA [c])	50	25	25	San Diego [a]	47/31/22	daily
Convenience market (16-hour)	25	30	45	ITE update	16/18/66 [b]	p.m. peak
Convenience market (24-hour)	25	30	45	ITE update	16/18/66 [b]	p.m. peak
Bank (walk-in only)	35	45	20	San Diego [a]	35/42/23	daily
Bank (with drive-through)	35	45	20	San Diego [a]	35/42/23	daily
General office building	80	20	0	San Diego [a]	77/19/4	daily
Office park	80	20	0	—	N/A	—
Government office building	70	30	0	—	N/A	—
Government (civic center)	70	30	0	San Diego [a]	50/34/16	daily
Medical office building	60	40	0	San Diego [a]	60/30/10	daily
Hospital	75	25	0	San Diego [a]	73/25/2	daily

Land Use	Recommended Percentages: Primary Trip	Diverted Linked Trip	Pass-By Trip	Available Data: Source	Trip Categories (Primary/Diverted/ Pass-By)	Time Period
General light industry	90	10	0	—	N/A	—
General heavy industry	95	5	0	San Diego [a]	92/5/3	daily
Industrial park	90	10	0	—	N/A	—
Manufacturing	90	10	0	—	N/A	—
Additional Land Uses						
Junior high school	65	35	0	San Diego [a]	63/25/12	daily
Junior college (2-year)	95	5	0	San Diego [a]	92/7/1	daily
University/college (4-year)	95	5	0	San Diego [a]	91/9/0	daily
Library	50	50	0	San Diego [a]	44/44/12	daily
Fast-food restaurant (with drive-through window)	30	30	40	ITE update	29/24/47	p.m. peak
Free-standing discount superstore (1)	55	40	5	San Diego [a]	45/40/15	daily
Discount club (2)	55	40	5	San Diego [a]	45/40/15	daily
Convenience market (with gasoline pumps)	20	30	50	ITE update	16/18/66	p.m. peak
Gasoline/service station	20	40	40	ITE update	21/21/58	p.m. peak
Neighborhood park (undeveloped)	70	30	0	San Diego [a]	66/28/6	daily

Notes:

N/A = data not available

[a] Trip category percentage ratios are from local household surveys and often cannot be applied to specific land uses. It should be noted that this source defines pass-by trips as trips that are either undiverted or are diverted by less than 1 mile, but in URBEMIS five pass-by trips are defined only as undiverted trips, and any diverted trip is considered to be a diverted linked trip.

[b] The data is for a convenience market with gas pumps.

[c] GLA = gross leasable area

Sources: Institute of Transportation Engineers 1991, 1995; San Diego Association of Governments 1990.

The H-W, H-S, and H-O trip lengths can be used directly in URBEMIS7G. However, for non home-based trips, URBEMIS7G uses work (W) and nonwork (N-W) trips when analyzing all nonresidential projects (e.g., commercial, industrial, institutional). To produce work-related trip lengths for nonresidential projects analyzed in URBEMIS, a composite work trip length is calculated that is a composite of H-W and O-W trip lengths. For URBEMIS, non-work trips are a composite of H-S, H-O, and O-O trip lengths. Both are based on the relative occurrence of the individual trip types.

Table C-3 illustrates this concept using Southern California data as an example:

Table C-3. Southern California Example

Travel Survey Trip Types	Percent Trip Type	Trip Length (minutes)	Trip Length (miles)
H-W	20	19.63	11.50
H-S	9	7.91	4.87
H-O	43	9.58	6.02
O-W	11	15.06	9.07
O-O	17	8.96	5.66
Total	100		

URBEMIS nonresidential work trip lengths = composite of H-W + O-W
URBEMIS nonresidential nonwork trip lengths = composite of H-S + H-O + O-O

Work Trip Length Formula:

*[%H-W / (%H-W + %O-W) * H-W trip length] + [%O-W / (%H-W + %O-W) * O-W trip length]*

Non-Work Trip Length Formula:

*[%H-S / (%H-S + %H-O + %O-O) * H-S trip length] + [%H-O / (%H-S + %H-O + %O-O) * H-O trip length] + [%O-O / (%H-S + %H-O + %O-O) * O-O trip length]*

Example Calculation Using South Coast Data

Commute Trip (W)

*(20% / (20% + 11%) * 11.5 miles)+ (11% / (20% + 11%) * 9.07 miles) = 10.6-mile W trip*

Nonwork Trip (N-W)

*(9% / (9% + 43% + 17%) * 4.87 miles) + (43% / (9% + 43% + 17%) * 6.02 miles) + (17% / (9% + 43% + 17%) * 5.66 miles) = 5.78-mile N-W trip*

Default Values for Emission Calculations

Diurnal Soak Hours per Day: 7.1

Resting Loss Hours per Day: 12.9

Vehicles per Household: 1.8

CITATIONS

Institute of Transportation Engineers. 1991. Trip generation, 5th edition. Washington, DC.

__________. 1995. Trip generation, February 1995 update to the 5th edition. Washington, DC.

California Air Resources Board. 1997. Emission inventory procedural manual, volume III: methods for assessing area source emissions. Sacramento, CA.

San Diego Association of Governments. 1990. San Diego traffic generators. California Department of Transportation, District 11. San Diego, CA.

U.S. Environmental Protection Agency. 1995. AIR CHIEF CD-ROM, Version 4.0. Research Triangle Park, NC.

Appendix D. "Mobile Source Mitigation Component" Documentation

MOBILE SOURCE MITIGATION COMPONENT

Background

The purpose of this appendix is to document the basis of the emission reduction quantification system used in the URBEMIS7G Mobile Source Mitigation Component (Component). It also describes how the various parts of the Component work together to determine project level emission reductions. Section III.8.2 explains how a program user would navigate through various selection screens and briefly describes information needed for setting each environmental factor in the Component.

The Component is a tool for quantifying emission reductions achievable by development projects under a wide range of conditions. It uses a two-step process. The first step creates "environmental factors" to take into account the effects of existing and planned development and transportation infrastructure near the project site on trip generation at the project site. The second step allows selection of specific measures that will result in emission reductions for projects. The Component then applies the factors set in step one to the mitigation measures selected in step two and arrives at a percent reduction in trips and reductions in vehicle miles traveled. URBEMIS then translates these trip and vehicle miles traveled (VMT) reductions into emission reductions.

Research related to factors affecting vehicle travel found that neighborhood level trip generation and vehicle miles traveled vary by as much as 50% in California cities (JHK & Associates 1995a). The primary factors cited for the variation were density, mix of uses, proximity of uses, transportation systems, and access. Areas with low trip generation and VMT levels and the greatest transit use and pedestrian activity also had the highest densities, a wide variety of uses within walking distance, safe and comfortable pedestrian access, paid parking requirements, and a high level of transit service. Areas with the highest trip generation and VMT levels had low development densities, strict separation of land uses, poor pedestrian access between land uses, abundant free parking, and poor transit service. Use of bicycles varied by orders of magnitude in different cities but the differences primarily resulted from access and safety considerations. The Component uses this information to determine a variable credit for applying mitigation measures to development projects.

The Component estimates trip reduction relative to Institute of Transportation Engineers (ITE) Trip Generation rates for a particular land use. ITE trip-generation data are primarily obtained from counts of the number of motor vehicles entering and leaving driveways at a project site. A number of studies of similar land uses are conducted and the results are statistically manipulated to obtain the trip-generation rate. People walking, bicycling, and using transit for their trips are not counted. This is significant because as was described earlier, a project's setting can dramatically affect the share of trips absorbed by transit, bicycling, and walking, and the overall trip generation rate. The Component attempts to use a project's environmental setting and mitigation measures to estimate the percentage of trips that will be diverted to these alternative modes of transportation compared to the averages used by the ITE.

BASIS AND DESCRIPTION OF COMPONENT ENVIRONMENTAL FACTORS

Introduction

The Component contains a series of screens requiring the user to set environment factors in three categories: pedestrian, transit, and bicycle. These factors are used later to determine the effectiveness of infrastructure- and design-based mitigation measures. The environmental factors provide a sliding scale that allows a project's trip generation to reflect levels achieved at real-world locations having similar conditions.

Pedestrian Environment

The pedestrian environment factor (PEF) is set by grading a project in each of seven factors. Each factor allows the user to select one of three possible scores or to skip the factor and assign a score of zero. The factors are weighted by setting the maximum possible score at between 2 for the least important factors and 5 for the most important factor. The weighting is based on review of the literature on walking and pedestrian enhancement. It uses concepts developed by Holtzclaw for the Bay Area (Holtzclaw 1994) and work done for the LUTRAQ project in Portland, Oregon (1000 Friends 1996). The seven different factors used in determining the PEF are listed in Table D-1.

Table D-1. Pedestrian Environment Point Ranges

Factor	Score Range in Points
Mixture of uses to attract pedestrians within walking distance. [a]	0–5
Sidewalks and pedestrian paths	0–3
Pedestrian circulation provides direct access	0–3
Street trees provide shade canopy	0–2
Street system designed to enhance pedestrian safety	0–2
Pedestrian routes provide safety from crime	0–2
Walking routes to important destinations provide visual interest	0–2
Total points possible	19

Notes:

[a] This factor is not included in this model.

Program users score the project being analyzed based on the environment within 1 mile of the project site. A 1-mile walking distance is based on maximum walking trip lengths described in the National Bicycling and Walking Study (Case Study 3). For small projects, the analysis would be based primarily on land beyond the project boundary. For large self-contained projects, the analysis would be based mostly on the internal design of the development. Because every project site is different, user judgment is required for determining the analysis boundary.

The heaviest weighted feature is the mixture of uses within walking distance. Without destinations to which to walk, all other features only enhance recreational walking. Distance comes into play again on pedestrian circulation providing direct access. With most people being unwilling to walk more than 0.25 mile (Cervero 1994) anything that creates barriers to pedestrian access and makes trip distances longer will discourage walking. Several features are listed that enhance pedestrians' comfort and safety during the walking trip. When routes are safe and attractive, pedestrians will walk longer distances, thus widening the range of potential trip destinations for a greater number of people.

The PEF is calculated by adding the scores for each factor and dividing the total by the maximum possible score. For example, a project that scores 12 of the possible 19 points would earn a PEF of 12/19 = 0.63. This is accomplished as an internal program calculation.

Transit Environment

The transit environment selection screen uses a 0–100 point scale for rating system effectiveness. The end points of the scale are anchored with dial-a-ride service at 0 and urban heavy rail service within 0.50 mile (BART) at 100. Intermediate data points between these two types of service were determined using two 1994 studies by Cervero (Transit-Based Housing in California: Evidence on Ridership Impacts and Rail-Oriented Office Development in California: How Successful?) The studies provide mode share data for heavy rail, commuter rail, and light rail systems in California. The studies also provide mode shares for development near transit and on a regional basis.

Bus service levels were based on mode shares achieved by urban and suburban bus services in California. More suburban cities with relatively poor fixed route bus service have about a 1% transit mode share (U.S. Census 1990).

The transit environment uses a distance decay factor to determine the relative effectiveness of light rail at 0.25 and 0.50 mile. The highest mode shares were achieved by developments within 0.25 mile of the light rail station. Using a distance decay factor of 0.85% per 100 feet (Cervero 1994), an additional 1,320 feet (0.25 mile) would result in an 11% reduction in effectiveness.

No credit is given for transit beyond 0.50 mile for rail and 0.25 mile for bus service. These distances are based on limits most people are willing to walk (Cervero 1994). Beyond 0.50 mile from rail, most people drive or use bus transit to get to the train station. Except in very urbanized areas, the number of people using a bus to get to rail transit is quite small. Because of cold start and hot soak emissions, the air quality benefit of people driving to rail is limited to the vehicle miles traveled (VMT) reduced by not driving the full distance. Its effects are more akin to those of a park and ride lot. Dial-a-ride services are considered 0 because they provide transportation for trips that would in most cases not have been made or would have been made by carpooling.

To account for the effect of the pedestrian environment on people's ability to walk to the transit stop or station, the Component uses a pedestrian accessibility adjustment (PAA). The PAA uses the PEF obtained in the previous screen. If the pedestrian environment is poor, fewer people will be willing to walk to the station, even if close. If the pedestrian environment is good, people will be encouraged to walk to the station or transit stop. The PAA is based on an assumption that transit use can be influenced by up to 10% by the pedestrian environment. This number is somewhat modest to reflect Cervero's 1994 finding that proximity and parking availability at the destination dominate other factors affecting transit.

After the level of transit service and the pedestrian environment have been set, the program calculates a transit environment factor (TEF) between 0 and 1. The TEF is based on the score achieved divided by the total possible score. For example, light rail within 0.50 mile is worth 40 points. If the project had an outstanding pedestrian environment factor of 1, the pedestrian adjustment is (10% * 40 * 1 = 4 points). The total score is then 44 out of a possible 110 and 44/110 = 0.4. A factor of 0.4 means that a project in this environment may achieve 40% of the maximum possible trip reduction for transit.

Bicycle Environment

The bicycle environment factor (BEF) selection screens list six factors affecting how much people will bicycle for purposes other than recreation. Bicycle distance for all measures is set at 5 miles based on the maximum cycling distance described in The National Bicycling and Walking Study Case Study 4 (U.S. Department of Transportation, Federal Highway Administration 1993). As with the PEF, each feature's points are weighted, in acknowledgment that some features are more important than others. The six features and their scoring ranges are listed on Table D-2. The BEF is calculated in the same manner as the PEF.

The BEF utilizes other information from The National Bicycling and Walking Study Case Study 4 to determine and weight factors affecting bicycle use. The weighted factors are based on surveys of what bicycle riders believe was preventing them from using a bicycle for transportation. The primary factors are directly or indirectly related to safety. The more safe and secure bicyclists feel as they ride, the more likely they are to use bicycles for transportation. The second most important consideration is distance. Since most bicycle trips are less than 5 miles in length and the average is around 2.5 miles, without a good mixture of uses within bicycling distance on safe routes, few people will choose to use a bicycle. Schools, particularly colleges and universities, are major contributors to bicycle mode shares. University towns like Davis and Palo Alto have very high bicycling rates. The final factor is secure bike parking at the destination.

Table D-2. Bicycle Environment Point Ranges

Factor	Score Range in Points
Area served by interconnected bikeways	0–5
Bike routes provide wide paved shoulders and few curb cuts	0–3
Speed limits of 30 mph or less on streets with bike routes	0–2
Schools with safe routes	0–5
Mixture of uses to attract bicyclists within easy cycling distance	0–3
Community has bike parking ordinance	0–2
Total points possible	20

BASIS AND DESCRIPTION OF THE MITIGATION MEASURE SELECTION AND QUANTIFICATION SYSTEM

Introduction

In the second step of the process, the user selects measures from a series of screens: transit, pedestrian and bicycle infrastructure, operational measures, and vehicle miles traveled reduction measures. Separate screens are provided for residential and commercial measures with the option available for viewing either or both sets of measures. Separate commercial and residential screens allow the program to credit measures to the appropriate trip types. The three sets of infrastructure based measure screens (transit, pedestrian, and bicycle) have a section called “project description measures”. These measures allow trip-reduction percentages to be credited to a project even when a project applicant provides no formal mitigation measures. It allows better prediction of trip-generation rates without applying unrealistically high benefits to individual measures. More discussion of project description measures is provided later.

Program users select measures appropriate for their project and the screen displays the maximum percent trip reduction possible. These numbers are later reduced by the environment factors determined in step one to ensure that the trip reduction credited is as accurate as possible.

The emission reduction percentages for individual infrastructure measures and operational measures are taken from trip reduction estimates from CEQA guidelines used by several California air pollution control districts, including South Coast, Sacramento, Bay Area, and Monterey Bay.

The program allows the user to add measures not listed on the measure screens. The amount of credit allowed, however, is limited to a maximum amount allowed for each type of measure (transit, bicycling, etc.). If, for example, an applicant identifies a bicycling measure not listed on the screen, the total amount of credit cannot exceed 9%. When more than 9% is listed, the program displays an error message. This is to prevent the program user from showing reductions beyond what is feasible to achieve.

Project Description Measures

Each infrastructure measure selection screen contains one to three "project description measures". The first measure in each case is a credit for pedestrian, transit, or bicycle environment. The concept can be explained with an example. An apartment complex is proposed for a site 0.25 mile from an existing light rail station. Future tenants of the complex are much more likely to use light rail than the average person yet the developer has no need or ability to provide transit-supporting infrastructure since it already exists. Therefore, a mechanism was needed to recognize the trip-reduction benefit of the decision to develop at that particular site. Thus, the credits for environment were devised. The amount of the credit was set at a level that would allow a project with the best possible environment and all feasible infrastructure measures to achieve mode shares found in the literature for similar projects. Because most projects fall well below the best, the environment factor is applied to the total to provide a comparison of a particular site with the best. The credit for environment is not a user selection. As long as the environmental factors are greater than zero, some credit is given to each project.

The second types of project description measures are user selected. These are different for each infrastructure measure screen. The transit screen includes a credit for project density meeting transit level of service requirements. The pedestrian screens include a credit for residential and commercial mixed-use projects and for commercial projects with high floor area ratios (FARs). These credits are used in the system devised by JHK & Associates for the Oregon Department of Environmental Quality (JHK & Associates 1995b). The bicycle screen contains no additional credits.

Transit Mitigation

For transit, the maximum achievable reduction has been set at 25%, based on the Cervero 1994 rail studies. This reduction is based on a 25% transit mode share in urban residential developments within walking distance of a BART station. Most of this potential reduction is due entirely to the developer's decision to locate near an existing or planned transit system. For this reason 15% of the possible 25% reduction is given as a credit for existing or planned community transit service. This number may seem high, but it will be reduced by the TEF in the next step.

The second measure, included as part of the project description is density. If project density is greater than or equal to the density standards needed to support the type of transit serving the site, 6 percentage points are awarded. Projects not meeting density standards degrade transit service and so are not awarded any points. Density standards are based on numbers developed by the State of Florida (Table D-3) and by Pushkarev and Zupan (Table D-4).

Table D-3. Transit Related Density Standards

Mode of Transit	Level of Service	Minimum Necessary Residential Density (Dwelling Units Per Acre)	Other Characteristics
Dial-a-bus	Many origins/destinations	6	Only if labor costs are not two times those of taxis.
Dial-a-bus	Fixed destination or subscription service	3.5–5	Lower figure if labor costs are two times those of taxis; higher if three times.
Local bus	Minimum 0.50-mile route spacing, 20 buses per day	4	Average varies as a function of downtown size and distance from residential area to downtown.
Local bus	Intermediate—0.50-mile route spacing, 20 buses per day	7	
Local bus	Frequent—0.50-mile route spacing, 120 buses per day	15	
Express bus reached on foot	Five buses during 2-hour peak	15—average density over 2-mile area	From 10–15 miles away to largest downtowns.
Express bus reached by auto	Five to 10 buses during 2-hour peak	3—average density over 20 square miles	From 10–20 miles away to downtowns large than 20 million square feet of nonresidential floor space.
Light rail	5-minute headways or better during peak	9—average density for corridor of 25 to 100 square miles	To downtowns of 20 million–50 million square feet of nonresidential floor space.
Rapid transit	5-minute headways or better during peak	12—average density for corridor of 100–150 square miles	To downtowns larger than 50 million square feet of nonresidential floor space.
Commuter rail	20 trains per day	1–2	To central business districts with rail.

Source: Florida Statewide Transit System Plan, Phase III, Development of State Transit Standards, October 1988.

Table D-4. Minimum Residential Densities to Support Different Levels of Transit Service

Mode of Transit Service	Frequency	Minimum Density DU/Res Acre
Frequent bus service	Every 10 minutes, 20 hours per day—120 buses/day 0.50 mile spacing over area	15
Rapid transit (heavy rail)		12
Light rail (street car, radial corridors)		9
Intermediate bus service	0.50 hourly, 20 hours per day— 40 buses/day	7
Minimal bus service	0.50 hourly, 10 hours per day or hourly, 20 buses per day	4
Commuter rail on existing track		2

Source: JHK & Associates 1995a.

The remaining 4 possible percentage points are awarded for infrastructure measures to be provided by the developer. The measures are assigned reductions ranging from 0.5–2% based on their relative contributions to making transit use more convenient and comfortable. These percentages are taken from trip reduction estimates in CEQA guidelines used by several California air pollution control districts.

If we return to our project served by light rail with the excellent pedestrian environment, and the developer provides the density and all infrastructure measures, then the actual percent trip reduction would equal 25% * 0.4 TEF = 10% reduction. We would expect 10% of work trips to be captured by the light rail system. This number is consistent with Cervero's findings for mode shares for residential development 0.50 mile from light rail.

Pedestrian Mitigation

Pedestrian mitigation measures are presented on two screens: residential projects and nonresidential projects. The maximum achievable reductions have been set at 9% for residential and nonresidential projects. The maximum reductions are derived mainly from an analysis of Bay Area travel surveys (Fehr and Peers 1992). This study provides mode shares for traditional versus suburban neighborhoods. Non-home-based trips in traditional neighborhoods achieve up to a 9% increase in pedestrian mode share over standard suburban development (Table D-5). Oregon's LUTRAQ study (1000 Friends 1996) contains pedestrian mode share information that confirms the Fehr and Peers information (Table D-6). Walk/bike mode share in TODs for "home-based other trips" (HBO) is 12.8% compared to 3.3% for the no-build alternative. Total home-base non-work (HB N-W) is 20.7% for TODs compared to 6% for the no-build alternative. Other trip types show similar reductions. The bottom level for pedestrian travel approaches 0 in very low-density suburban or rural settings. Some projects may have no destinations within walking distance.

Table D-5. Trip Differences Between Traditional and Suburban Bay Area Neighborhoods for Walking Trips

	Percentages		
Trips	**Traditional Neighborhoods**	**Suburban Neighborhoods**	**Difference**
Home-based work	4	3	1
Home-based non work	14	10	4
Work-based other	15	8	7
Non-home-based trips	17	8	9
All trips combined	12	8	4

Source: Based on Fehr and Peers. Metropolitan Transportation Commission Bay Area Trip Rate Survey Analysis, Oakland, CA. MTC 1992.

Table D-6. Walk/Bike Mode Choice from LUTRAQ (by percentage of trip type)

Trip Type	No-Build Alternative	LUTRAQ TOD Only (adj.)	Difference
Home-based work	2.8	6.1	3.3
Home-based non-work	6.0	20.7	14.7
Total home-based	5.1	17.2	12.1
Non-home-based work	0.4	13.1	12.7
Non-home-based non-work	0.3	10.2	9.9
Total non-home based	0.3	11.4	11.1
Total all trips	3.8	15.6	11.8

Source: 1000 Friends of Oregon 1996.

Work-based customer trips achieve very high pedestrian mode shares in high-density downtown settings compared to suburban settings. The ARB's shopping center study (JHK & Associates 1993) found that regional shopping centers in two California low-density suburban settings had pedestrian mode shares of 0.7 and 1.6% (Table D-7). A shopping center in a high-density suburban setting had a 21.7% pedestrian share and another in a high-density urban setting had a 28.9% share.

Although the pedestrian mitigation screens allow a maximum trip reduction of 9%, operational measure screens account for other trips reduced. For example, an additional reduction of up to 10% may be added on the operational measure screen if the employees and customers must pay for parking. This parking credit is included in the operational measures section because it increases all alternative mode use, not just walking. Two percent of the possible 9% is given as a credit for the surrounding pedestrian environment, 1% is awarded if the project is a commercially oriented mixed-use project, and an additional 1% if its FAR is 0.75 or greater.

Table D-7. Walking Mode Shares in California Regional Shopping Centers (Percent)

Suburban Low-Density 1	Suburban Low-Density 2	Suburban Medium-Density	Suburban High-Density	Urban High-Density
0.7	1.6	19.3	21.7	28.9

Source: JHK & Associates for California Air Resources Board. Analysis of Indirect Source Activity at Regional Shopping Centers, Final Report A132-094. November 1993.

For residential projects, 2% of the possible 9% is allotted as a credit for the surrounding pedestrian environment, and an additional 3% is awarded if the project is a residentially oriented mixed-use project. The remaining 4 possible percentage points for residential projects and 5 points for nonresidential projects are awarded for infrastructure measures to be provided by the developer. The measures are assigned reductions ranging from 0.25–1% based on their relative contributions to making pedestrian travel more safe, comfortable, and convenient. These numbers are generally based on percentages used in the air district CEQA guidelines referred to earlier.

Bicycle Mitigation

Bicycle mitigation measures are presented on two screens: residential and nonresidential projects. The range in trip-reduction effectiveness for bicycles is very broad. In Davis, bicycling captures about 25% of work trips. In Palo Alto, about 10% of all trips are accomplished by bicycle (U.S. Department of Transportation, Federal Highway Administration 1993). At the bottom of the scale, many cities achieve less than 1% bicycle mode share. For both residential and nonresidential projects, the maximum achievable mitigation credit was set at 9% to reflect a level of improvement from the typical 1% to the outstanding 10% achieved by Palo Alto. Davis was not used as the maximum because it would skew the percent trip reductions excessively highly. Although it is possible to recreate the environment and bicycle infrastructure that led to Davis' high bicycle mode share, the attitude of local residents toward bicycling would take many years to cultivate.

The remaining 2 possible percentage points for residential projects and 4 points for nonresidential projects are awarded for infrastructure measures to be provided by the developer. The measures are assigned reductions ranging from 1–2 percent based on their relative contributions to making bicycle travel safer, and more comfortable, and convenient.

Operational Measures

Operational mitigation measures are divided among three screens based on the type of trip impacted. The first set of measures apply to commute trips. These include some measures that may be provided by an employer and other measures that may be obtained from other service providers or that take advantage of the existing built environment. Examples of the former are a compressed work schedule and preferential carpool parking. Examples of the latter are an office built in an area with limited, paid parking not owned or leased by the employer. The second set of measures applies to employee shopping trips and errands. Some measures have the employer provide services at the employment site that employees would normally have to use a car to obtain. The second strategy is to provide alternative transportation in the form of a shuttle to lunch and shopping areas out of walking range of the employment site. The third set of measures applies to customer and client trips. The only measure listed in this case is paid parking.

The percentage reductions used for the operational measures were taken from CEQA Guidelines used by several California air pollution control districts. Use of compressed work schedules provides up to a 40% reduction for businesses having 100% of their employees on a 3/36 work schedule (3 days/week, 12 hours/day). Charging for parking is the next most effective measure, allowing up to a 10% reduction in areas with high daily parking charges.

Measures Reducing Vehicle Miles Traveled (VMT)

The final set of screens include measures that usually do not reduce vehicle trips, but do reduce vehicle miles traveled (VMT). The two measures included are park-and-ride lots and satellite telecommuting centers. These could either be provided by or in proximity to a residential development or by a commercial development.

The input screen for these measures require the user to provide the number of people that can use the facilities. For example, on any given day a park-and-ride lot with 100 spaces can be used by 100 drivers. The number of spaces is then multiplied by 89% to account for the average portion of the trip driven by private vehicle to the park-and-ride lot or to the telecommuting center (Monterey Bay Unified Air Pollution Control District 1995). Currently, the program assumes 100% use of the facility. This may be reduced based on local conditions. For telecommuting measures, the program assumes that facilities will be used by employees 2 days per week. If a business allows telecommuters greater or lesser use, the percent employees participating can be adjusted to reflect the actual trip reduction benefit. For example, if 10% of employees are telecommuting 5 days per week, the percent employees should be adjusted from 10% to 25% to compensate for the higher days per week. If 10% of all employees are telecommuting only 1 day per week, the percentage should be adjusted to 5%.

Another potential measure not currently listed on the VMT measure screen is rail station parking. Developments in communities served by rail, but farther than 0.5 mile from a rail station will achieve reduction in VMT not accounted for in the transit screens discussed earlier. Using BART as an example, 5.5% of station area residents drove to the station compared to 80% of all suburban Bay Area residents (Cervero 1994). Using citywide work trip mode splits for BART of 4.4% for Hayward, and the 80% drive to station statistic, VMT reduction would apply to 4.4% * 80% = 3.5% for suburban communities served by BART. Therefore, a development generating 100 work trips in a community with a BART station would reduce VMT by 3.5 trips * average trip length for work trips (10 miles) * trip length driven to the station (5 miles) divided by the total home to work trip length (10 miles) = 35 miles.

The calculation methodology is as follows:

$$\frac{RTMD * \%DTS * AWTL * H\text{-}SATL}{H\text{-}WATL * \#PWT} = MS$$

Where:

RTMD = citywide mode share for rail transit
%DTS = percent expected to drive to the station
AWTL = average work trip length
H-SATL = average trip length from home to station
H-WATL = average trip length home to work
#PWT = number of work trips for the particular project
MS = miles saved by rail transit system

The number of work trips can be obtained from URBEMIS7G. For example, for a residential development in Sacramento, 27.8% of trips are home to work trips. Each residence generates 9.6 trips per day, so .278 * 9.6 = 2.7 work trips per residence. A 100-unit residential development would generate 270 work trips.

If data are available for all trip types, they may be used to calculate VMT reductions from all trips instead of just the commute trip. The example used above is based on work trips because rail mode split data were located for only work trips.

CORRECTION FACTORS

Trip Type Correction Factors

URBEMIS7G calculates emissions based on six trip types: home-based trip types are home to work (H-W), home to shop (H-S), home to other (H-O), and trips for commercial land uses include work trips (W), non-work employee trips (N-W-Emp), and non-work customer trips (N-W Cust). A number of studies show that certain trip types are more likely to be captured by one mode rather than another. The calculation procedure uses a correction factor to account for these differences. Trip type correction factors are provided in Table D-8.

Table D-8. Trip Type Correction Factors

	H-W	H-S	H-O	W	N-W Emp	N-W Cust
Transit	1.0	0.22	0.27	1.0	0.02	1.0
Pedestrian	0.11	0.44	0.44	0.11	1.0	1.0
Bicycle	1.0	1.0	1.0	1.0	1.0	1.0

Sources: Cervero 1994a, 1994b; JHK & Associates 1993.

The commute trip is most likely to be made using transit while shopping trips are the least likely to be made by transit. To determine the correction factor, the best trip type was set equal to one (1). To determine the correction factors for the other trip types their mode shares were divided by the mode share of the highest trip type. For example, if the home to work mode share is 19% and the home to shop mode share is 4.1%, then the correction factor is 4.1% / 19% = 0.22. The correction factor is then multiplied by the trip reduction achieved on the mitigation measure screen to account for the lower effectiveness for this type of trip. For the light rail example previously discussed, work trips achieve a 10% reduction, but home to shopping trips achieve reduction of 10% * 0.22 = 2.2%. The correction factor for transit was derived from Cervero's 1994 survey data for work trips, shopping trips, and other trips for all rail systems in the study.

The correction factor for non-work employee trips was taken from Cervero (1994a). Cervero found that only 2% of people who commuted by rail transit used rail for their midday trips.

Non-work customer trips provide an additional challenge. In an urban setting well served by a regional transit system, 32.5% of shoppers arrived by transit to a regional shopping center (JHK and Associates 1993). However, we would expect other commercial developments and service-based offices to attract fewer transit riders. Therefore the correction factor was set at 1.0 pending receipt of data on these other types of developments.

Bicycle trip reduction percentages are based on overall trip reduction and not on trip reduction for each trip type. This means that no trip type correction factors are needed. If trip type data are available for bicycling, the program has the capability to use them.

Trip Distance Correction Factors

Trip distance correction factors are needed to account for the fact that bicycle and walking trips replace mostly shorter automobile trips. Trips accomplished by bicycling or walking are reducing less emissions than would be generated using the average vehicle trip lengths used in URBEMIS7G. This is complicated by cold start and hot soak emissions that are generated by both long and short trips. The longest trips are work trips. In most jurisdictions the work trip now exceeds 10 miles. With the average walking trip at 0.5 mile, 5% of the running emissions of the average work trip would be reduced plus cold start and hot soak emissions. For home to shopping trips the average trip length is about 5 miles. So, for H-S trips about 1/10 (0.50 mile walk/5 mile drive) of the running emissions would be reduced. For bicycling the average trip length is 2.5 miles; therefore, the correction factors are higher than for walking.

Table D-9 contains the percent of emissions reduced by bicycling and walking trips for two trip distances. The trip distance correction factor is currently based only on ROG.

Table D-9. Comparison of Emissions from Trips Replaced with Walking and Bicycling (Percent)

	ROG	NO_x	CO	PM_{10}
0.5 mile walking/5-mile car trip	60	23	46	10
0.5 mile walking/10-mile car trip	42	12	29	5
2.5 miles on bike/5-mile car trip	78	57	70	50
2.5 miles on bike/10-mile car trip	54	31	44	25

Note: Comparison of emissions generated by 100-unit residential subdivision generating 1,030 trips using all defaults except trip length for a summer run in URBEMIS7G. Separate runs were done for 0.5, 2.5, 5.0, and 10.0 miles.

The trip distance correction factors (Table D-10) were estimated using an average trip length for automobiles of 5.0 miles for home to shopping, home to other, and non-work commercial-based trips, and 10.0 miles for commute trips. The pedestrian trip length was set at 0.5 mile and the bicycle trip was set at 2.5 miles based on information from the National Bicycling and Walking Study.

TABLE D-10. Trip Distance Correction Factors for ROG

	H-W	H-S	H-O	W	N-W Emp	N-W Cust
Pedestrian	.42	.60	.60	.42	.60	.60
Bicycle	.54	.78	.78	.54	.78	.78

Source: URBEMIS7G, Version 1.1

Future upgrades to URBEMIS could provide correction factors for each pollutant based on trip lengths input by the user or the air district. Jurisdictions with short average trip lengths will tend to have higher correction factors because more trips will be within walking and cycling distance. The calculation method would be as follows:

- Determine average trip lengths for each trip type used by URBEMIS.
- Determine average trip lengths for bicycling and walking if different than default values.
- Perform URBEMIS runs for each trip length, setting one trip type equal to 100% and others equal to 0%.
- Determine the ratio for each trip type and each pollutant by dividing the total emissions for the walking trip distance by the total emissions for each trip type. For example, emissions using walk trip distance/emission using home to work trip distance.
- The ratios obtained are the trip length correction factors that will then be applied to the trip reduction percentages for each pollutant.

This may be a programming challenge because the program currently calculates emission reductions based on trip and VMT reductions, not on emission reductions by pollutant.

LIMITATIONS OF THE MITIGATION COMPONENT

The URBEMIS7G mitigation component is a significant advance over past attempts to quantify the benefits of air quality mitigation measures, however, users should recognize that travel behavior is very complex and difficult to predict. The component relies on the user to determine factors critical to travel behavior that are somewhat subjective. As GIS and electronic traffic monitoring and data collection become a reality in many cities, the ability to identify factors critical to walking, bicycling, and transit use will be enhanced. The URBEMIS7G mitigation component provides a starting point for using currently available data to demonstrate the benefits of urban design and traditional mitigation measures in reducing air quality impacts.

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Appendix E. California Air District Contacts

CALIFORNIA AIR POLLUTION CONTROL DISTRICTS
(URBEMIS CONTACTS AND GENERAL PHONE NUMBERS)

AMADOR COUNTY APCD (all of Amador County)
500 Argonaut Lane
Jackson, CA 95642-2310
Karen Huss (209) 223-6406

ANTELOPE VALLEY APCD (NE portion of Los Angeles County)
43301 Division Street, Suite 206
P.O. Box 4409
Lancaster, CA 93539-4409
Charles Fryxell (661) 723-8070

BAY AREA AQMD (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, W portion of Solano, and S portion of Sonoma counties)
939 Ellis Street
San Francisco, CA 94109-7714
Henry Hilken (415) 771-6000

BUTTE COUNTY AQMD (all of Butte County)
2525 Dominic Drive, Suite J
Chico, CA 95928-7184
Larry Odle (530) 891-2882

CALAVERAS COUNTY APCD (all of Calaveras County)
Government Center
891 Mountain Ranch Road
San Andreas, CA 95249-9709
Lakhmir Grewal (209) 754-6504

COLUSA COUNTY APCD (all of Colusa County)
100 Sunrise Blvd. #F
Colusa, CA 95932-3246
Harry Krug (530) 458-0590

EL DORADO COUNTY APCD (all of El Dorado County)
2850 Fairlane Court, Bldg. C
Placerville, CA 95667-4100
Dennis Otani (530) 621-6662

FEATHER RIVER AQMD (all of Sutter and Yuba counties)
938 14th Street
Marysville, CA 95901-4149
Steven Speckart (530) 634-7659

GLENN COUNTY APCD (all of Glenn County)
P.O. Box 351 (720 N. Colusa Street)
Willows, CA 95988-0351
Kevin Toganowa (530) 934-6500

GREAT BASIN UNIFIED APCD (all of Alpine, Inyo, and Mono counties)
157 Short Street, Suite 6
Bishop, CA 93514-3537
Duane Ono (760) 872-8211

IMPERIAL COUNTY APCD (all of Imperial County)
150 South 9th Street
El Centro, CA 92243-2801
Stephen Birdsall (760) 339-4314

KERN COUNTY APCD (E portion of Kern County)
2700 "M" Street, Suite 302
Bakersfield, CA 93301-2370
Thomas Parson (661) 862-5250

LAKE COUNTY AQMD (all of Lake County)
883 Lakeport Blvd.
Lakeport, CA 95453-5405
Robert Reynolds (707) 263-7000

LASSEN COUNTY APCD (all of Lassen County)
175 Russell Avenue
Susanville, CA 96130-4215
Kenneth Smith (530) 251-8110

MARIPOSA COUNTY APCD (all of Mariposa County)
P.O. Box 2039 (5101 Jones Street)
Mariposa, CA 95338-2039
Dr. Charles Mosher (209) 966-2220

MENDOCINO COUNTY AQMD (all of Mendocino County)
306 E. Gobbi Street
Ukiah, CA 95482-5511
Philip Towle (707) 463-4354

MODOC COUNTY APCD (all of Modoc County)
202 West 4th Street
Alturas, CA 96101-3915
Joe Moreno (530) 233-6419

MOJAVE DESERT AQMD (N portion of San Bernardino County, & E portion of Riverside County)
15428 Civic Drive, Suite 200
Victorville, CA 92392-2383
Cynthia Ravenstein (760) 245-1661

MONTEREY BAY UNIFIED APCD (all of Monterey, San Benito, Santa Cruz counties)
24580 Silver Cloud Court
Monterey, CA 93940-6536
Janet Brennan (831) 647-9411

NORTH COAST UNIFIED AQMD
2389 Myrtle Avenue
Eureka, CA 95501
Wayne Morgan (707) 443-3093

NORTHERN SIERRA AQMD (all of Nevada, Plumas, Sierra counties)
200 Litton Drive, Suite 320
P.O. Box 2509
Grass Valley, CA 95945-2509
APCO - Rod Hill (530) 274-9360

NORTHERN SONOMA COUNTY APCD (N portion of Sonoma County)
150 Matheson Street
Healdsburg, CA 95448-4908
APCO - Barbara Lee (707) 433-5911

PLACER COUNTY APCD (all of Placer County)
DeWitt Center
11464 "B" Avenue
Auburn, CA 95603-2603
Dave Vintze (530) 889-7130

SACRAMENTO METRO AQMD (all of Sacramento County)
8411 Jackson Road
Sacramento, CA 95826-3904
Greg Tholen (916) 874-4800

SAN DIEGO COUNTY APCD (all of San Diego County)
9150 Chesapeake Drive
San Diego, CA 92123-1096
Robert Reider (858) 650-4700

SAN JOAQUIN VALLEY UNIFIED APCD (all of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare, and W portion of Kern counties)
1990 E. Gettysburg Avenue
Fresno, CA 93726
(Central - Fresno)
Dave Mitchell (559) 230-5807
(South - Bakersfield)
Joe O'Bannon (661) 362-6900
(North - Modesto)
John Cadrett (209) 557-6400

SAN LUIS OBISPO COUNTY APCD (all of San Luis Obispo County)
3433 Roberto Court
San Luis Obispo, CA 93401-7126
Larry Allen (805) 781-5912

SANTA BARBARA COUNTY APCD (all of Santa Barbara County)
26 Castilian Drive Suite B-23
Goleta, CA 93117-3027
Vijaya Jammalamadaka (805) 961-8800

SHASTA COUNTY AQMD (all of Shasta County)
1855 Placer Street, Suite 101
Redding, CA 96001-1759
Mike Kosson (530) 225-5674

SISKIYOU COUNTY APCD (all of Siskiyou County)
525 So. Foothill Drive
Yreka, CA 96097-3036
William Stephans (530) 841-4029

SOUTH COAST AQMD (Los Angeles County [except for area within the Antelope Valley APCD], Orange County, west portion of San Bernardino and west portion of Riverside counties)
21865 E. Copley Drive
Diamond Bar, CA 91765-4182
Steve Smith (909) 396-2068

TEHAMA COUNTY APCD (all of Tehama County)
P.O. Box 38 (1750 Walnut Street)
Red Bluff, CA 96080-0038
Mark Black (530) 527-3717

TUOLUMNE COUNTY APCD (all of Tuolumne County)
22365 Airport
Columbia, CA 95310
Gerald Benincasa (209) 533-5693

VENTURA COUNTY APCD (all of Ventura County)
669 County Square Drive, 2nd Floor
Ventura, CA 93003-5417
Chuck Thomas (805) 645-1400

YOLO-SOLANO AQMD (all of Yolo and east portion of Solano counties)
1947 Galileo Court, Suite 103
Davis, CA 95616-4882
Carl Vandagriff (530) 757-3650

Appendix F. State Of California Counties And Air Basins

A map is available on the Internet at the following Web sites:

- http://www.arb.ca.gov/emisinv/maps/statemap/dismap.htm
- http://www.arb.ca.gov/capcoa/roster.htm

Appendix G. Average Summer and Winter Temperatures

Table G-1. Average Summer Ozone Temperatures

Air Basin	County	6 a.m. to 9 a.m.	9 a.m. to noon	noon to 3 p.m.	3 p.m. to 6 p.m.	Average Temperature
Great Basin	Alpine	57	70	72	68	67
	Inyo	72	90	97	93	88
	Mono	63	79	79	79	75
Lake County	Lake	71	87	94	91	86
Lake Tahoe	El Dorado*	55	74	78	75	71
	Placer*	55	74	78	75	71
Mountain Counties	Amador	80	87	90	89	87
	Calaveras	80	87	90	89	87
	El Dorado*	72	82	85	85	81
	Mariposa	80	87	90	89	87
	Nevada	71	80	84	83	80
	Placer*	80	85	88	88	85
	Plumas	71	80	84	83	80
	Sierra	71	80	84	83	80
	Tuolumne	80	87	90	89	87
North Coast	Del Norte	51	55	57	57	55
	Humboldt	51	55	57	57	55
	Mendocino	51	55	57	57	55
	Sonoma*	51	55	57	57	55
	Trinity	54	79	87	87	77
North Central Coast	Monterey	56	70	78	73	69
	San Benito	57	72	79	74	71
	Santa Cruz	52	70	83	78	71
North East Plateau	Lassen	60	74	82	83	75
	Modoc	47	70	80	80	69
	Siskiyou	60	74	82	83	75
South Coast	Los Angeles*	74	85	89	83	83
	Orange	70	80	83	80	78
	Riverside*	78	92	98	93	90
	San Bernardino*	76	92	98	93	90
South Central Coast	San Luis Obispo	64	80	85	79	77
	Santa Barbara	66	72	77	75	73
	Ventura	67	77	78	73	74
San Diego	San Diego	70	88	91	85	84
South East Desert	Imperial	90	99	105	103	99
	Kern*	84	96	101	99	95
	Los Angeles*	79	91	96	91	89
	Riverside*	86	97	101	99	96
	San Bernardino*	82	94	101	101	95
San Francisco	Alameda	64	74	82	80	75

Table G-1. Average Summer Ozone Temperatures

Air Basin	County	6 a.m. to 9 a.m.	9 a.m. to noon	noon to 3 p.m.	3 p.m. to 6 p.m.	Average Temperature
	Contra Costa	66	82	92	95	84
	Marin	57	76	89	92	79
	Napa	66	82	93	91	83
	San Francisco	67	83	87	77	79
	San Mateo	62	73	83	80	75
	Santa Clara	66	80	90	89	81
	Solano*	67	83	94	96	85
	Sonoma*	59	81	94	92	82
San Joaquin Valley	Fresno	73	88	98	102	90
	Kern*	78	89	97	100	91
	Kings	73	88	96	100	89
	Madera	71	86	96	99	88
	Merced	70	84	94	96	86
	San Joaquin	66	77	91	93	82
	Stanislaus	67	73	91	94	81
	Tulare	73	87	95	97	88
Sacramento Valley	Butte	75	87	97	99	90
	Colusa	71	87	97	99	89
	Glenn	76	91	99	100	92
	Placer*	80	85	88	88	85
	Sacramento	69	84	97	100	88
	Shasta	74	93	103	105	94
	Solano*	67	83	94	96	85
	Sutter	77	92	99	100	92
	Tehama	75	92	101	103	93
	Yolo	66	82	95	97	85
	Yuba	77	92	99	100	92

* Parts of some counties are located in more than one air basin. Use the county and air basin in which the project is located.

Source: California Air Resources Board

Table G-2. Average Winter Carbon Monoxide Temperatures

Air Basin	County	6 a.m. to 9 a.m.	9 a.m. to noon	noon to 3 p.m.	3 p.m. to 6 p.m.	Average Temperature
Great Basin	Alpine	18	26	34	28	27
	Inyo	19	46	48	28	35
	Mono	18	26	34	28	27
Lake County	Lake	39	48	60	59	52
Lake Tahoe	El Dorado*	16	32	40	33	30
	Placer*	39	52	48	46	46
Mountain Counties	Amador	23	39	44	32	35
	Calaveras	23	39	44	32	35
	El Dorado*	16	32	40	33	30
	Mariposa	37	43	41	38	40
	Nevada	35	45	57	52	47
	Placer*	39	52	48	46	46
	Plumas	36	46	47	43	43
	Sierra	35	45	57	52	47
	Tuolumne	23	39	44	32	35
North Coast	Del Norte	39	48	60	59	52
	Humboldt	39	48	60	59	52
	Mendocino	39	48	60	59	52
	Sonoma*	39	48	60	59	52
	Trinity	39	48	60	59	52
North Central Coast	Monterey	41	51	60	58	53
	San Benito	50	59	65	60	59
	Santa Cruz	47	58	66	65	59
North East Plateau	Lassen	19	30	47	44	35
	Modoc	19	30	47	44	35
	Siskiyou	28	34	41	40	36
South Coast	Los Angeles*	52	68	72	64	64
	Orange	53	67	71	66	64
	Riverside*	56	72	75	68	68
	San Bernardino*	53	72	79	73	69
South Central Coast	San Luis Obispo	39	56	70	66	58
	Santa Barbara	51	64	70	64	62
	Ventura	55	64	68	64	63
San Diego	San Diego	48	68	76	69	65
South East Desert	Imperial	52	72	81	75	70
	Kern*	41	57	64	59	55
	Los Angeles*	35	52	63	60	53
	Riverside*	50	64	70	66	63
	San Bernardino*	48	61	71	68	62

Table G-2. Average Winter Carbon Monoxide Temperatures

Air Basin	County	6 a.m. to 9 a.m.	9 a.m. to noon	noon to 3 p.m.	3 p.m. to 6 p.m.	Average Temperature
San Francisco	Alameda	50	57	62	60	57
	Contra Costa	40	49	58	57	51
	Marin	42	58	66	62	57
	Napa	40	50	59	58	52
	San Francisco	47	57	61	55	55
	San Mateo	47	57	61	55	55
	Santa Clara	47	60	68	64	60
	Solano*	40	50	59	58	52
	Sonoma*	42	58	66	62	57
San Joaquin Valley	Fresno	38	51	64	67	55
	Kern*	34	45	57	57	48
	Kings	37	48	62	61	52
	Madera	43	53	56	50	51
	Merced	42	52	63	64	55
	San Joaquin	39	52	64	61	54
	Stanislaus	42	57	67	62	57
	Tulare	38	54	64	60	54
Sacramento Valley	Butte	39	51	62	62	54
	Colusa	37	52	64	61	54
	Glenn	39	55	67	63	56
	Placer*	39	52	61	63	54
	Sacramento	39	52	61	63	54
	Shasta	36	45	53	52	47
	Solano*	36	47	57	57	49
	Sutter	33	37	48	55	43
	Tehama	42	57	66	61	57
	Yolo	36	47	57	57	49
	Yuba	39	51	62	62	54

* Parts of some counties are located in more than one air basin. Use the county and air basin in which the project is located.

Source: California Air Resources Board